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16169

DP/ID/SER.A/816
2 March 1987
ENGLISH

ASSISTANCE TO THE ARTEPRACTICO FURNITURE FACTORY

SI/ECU/85/802

ECUADOR

Technical report: Assessment and recommendations *

Prepared for the Government of Ecuador
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Desmond P. Cody,
furniture production consultant

Backstopping officer: A.V. Bassili, Agro-based Industries Branch

United Nations Industrial Development Organization
Vienna

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N O T E S

Reference to dollars are to United States Dollars unless otherwise stated.

The monetary unit in Ecuador is the Sucre. During the period covered by this report the official value of the Sucre in relation to the United States Dollar was $1 = S/140 .

The following abbreviations and symbols are used in this report:

B.S.I.	British Standards Institute
D I N	Deutsche Industrie Normen
FIRA	Furniture Industry Research Association
K D	Knock-Down
N C	Nitro-Cellulose
S A	Self-Assembly
O T	Overtime

A B S T R A C T

This report contains a description of certain aspects and activities of the Artepractico Furniture Factory together with an assessment of its potential. It also sets out some of the criteria by which it should be developed in the future with particular reference to exports. Further technical assistance is recommended with the help of the United Nations Industrial Development Organisation.

Problem areas and shortcomings are identified which must be dealt with as a matter of urgency. These refer in particular to product design, marketing, production management expertise, raw materials procurement, production technology, productivity and quality control.

Reference is also made to the need for further formal training in production supervision.

The recommendations arrived at in respect of the foregoing are incorporated in the text and are also summarised in the chapter dealing with conclusions and recommendations.

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I INTRODUCTION

The Artepractico furniture factory was established in Cuenca, Ecuador in 1962 and moved to its present, much enlarged site and premises, in 1980. At that time, it was envisaged that the newly equipped plant, which includes a sawmill and particle board plant as well as the furniture one, would service both the Ecuador market and that of the surrounding countries.

However, this plan never fully materialised mainly because a crisis arose in connection with the implementation of the Andean Pact. Since then the enterprise has endeavoured to operate under severe financial and marketing constraints which, with the advent of new management in 1985 is gradually being brought under control.

This is being done through a re-organization and development programme which, among other things, calls for the establishment of exports of particle board in its various forms and of furniture.

The United Nations Industrial Development ~~Authority~~ Organization (UNIDO) under its programme of technical co-operation with DINATI was requested through the United Nations Development Programme (UNDP) to provide technical support services towards this end. These would take the form of inplant advisory services in production, process/product adaptation, quality assurance and management and export planning, including market control, and the training, where appropriate, of technical and managerial personnel.

Accordingly, a UNIDO furniture production consultant was appointed to carry out a two-phase, three month assignment in the Artepractico furniture plant with the objective of assessing its current stage of development, identifying shortcomings in respect of export development and preparing and assisting in the implementation of an export development plan.

Phase I of the project began on 27th May 1986 and ended on 6th July 1986, during which time an indepth assessment of the Artepractico furniture plant was carried out and discussions were held with the management of the plant and relevant DINATI officials. Phase II began on 6th October 1986 and ended on 17th Oct. 1986 . The consultants Job Description is given in Annex I

Dr. Victor Hugo Pesantez, Head of Material Quality Control was assigned to be the interpreter to the consultant who worked as closely as possible with other senior management staff, particularly in production and marketing.

The management personnel of Artepractico and others that co-operatedwith the consultant are listed in Annex II.

An industrial profile of Artepractico S.A. is provided in Annex III.

II FINDINGS

A. Current Products and Product Design.

1) Visual Characteristics:

There are three main Artepractico product ranges namely, solid wood furniture (tables and chairs), corpus furniture (storage elements) and upholstery (seating and sleeping units). Each of these three categories is subdivided into modern and traditional styles. On the basis of current export market standards the range of items throughout all three categories was found to be below that which would be acceptable both in design and quality.

The main criticism is concerned with the almost total lack of enterprise product identity. Items designed and made by Artepractico do not incorporate an identifiable Artepractico image and this must inevitably lead to greater and more difficult competition with other manufacturing companies either in or outside Ecuador. The current practice of endeavouring to maintain volume sales through copying other's successful designs can only find limited market response and requires hard selling and expensive promotional exercises. Mounting stocks of unsold furniture in the company's warehouse bear ample witness to this state of affairs. Moreover, in an export situation, this would certainly end in a price battle with competitors, thereby reducing profitability and weakening sales growth.

Although there are signs of a visual design theme in the latest modern corpus range produced by Artepractico, there is a distinct absence of this in the traditional hard furniture and upholstery items and their individual appearances are devoid of any linking motif. The importance of this linking theme is best illustrated by considering the following:

a) To-day's greater emphasis on open-plan living, signalling the need for increased flexibility in furniture items which can be used equally well in bedroom, dining-area or living room.

b) Economic pressures which prevent many customers from buying all the furniture they need at one time. A constant design theme allows for continuity and a longer production life, thus making it possible for purchasers to add to their furniture as their economic condition improves.

c) The establishment of a discernible product image would enable more standardization of components, reduce production costs and ease production planning.

The traditional ranges of Artepractico furniture i.e. dining room, bedroom and living room units, apart from having some related features in themselves, are completely different in character from the traditional upholstery products and do not appear as if they could happily live together, much less be marketed together. Differences also occur between modern upholstery and the modern corpus furniture where the massive proportions of the seating elements contrast unfavourably with the austere lines of the California units.

2) Function/Usefulness:

This is a major factor of good design and the usefulness of Artepractico furniture may be criticised objectively in this respect and appropriate recommendations made to achieve a higher degree of usefulness-thus making the furniture more acceptable to a would-be purchaser. This applies, in particular, to the comfort of the range of seating manufactured by the company. Comfort encompasses a variety of subjective reactions but its prime requirement in seating is that it conforms to the anatomical dimensions of the potential user.

Since the human body varies from person to person in measurement and weight, an above average size should be accepted as the norm. Where, for example, seat width is being considered, the larger individual must be catered for and as a consequence, it suits the smaller individual also. Looked at from this point of view, it may be said that few, if any, of the Artepractico seating models are truly comfortable.

3) Dining Chairs:

In dining or working chairs there were found to be many variations in seat height and depth and the backrests of all provided incorrect lumbar (lower part of the back) support. In each case, the back was too vertical from the back edge of the seat. With most chairs, a change of angle from seat to back is not only necessary but is easily achieved and would certainly enhance the chair's appearence.

The following is a useful guide to dining chair dimensions and comfort:

Seat height	:	400 450 mm
Seat depth	:	400 mm
Back rest (lumbar)		
height	:	200 - 300 mm
width	:	300 - 380 mm
Slope of seat	:	3° - 5°
Angle between seat and backrest at lumbar area	:	100° - 105°

4) Upholstery:

In the upholstery ranges, the couches and armchairs are not only too large visually but the dimensions are also too large for the relaxed comfort of the human body. Cushioning in the seating is too dense and prevents the body from sinking in and forming its own shape. Backs of armchairs and couches are too far away from the front edge of the seats and do not provide the body with support until the sitter is so far back that his/her legs are no longer supported by the floor. This is the result of the seat depth being too long. In some instances the seat was found to be too high off the floor and this was further accentuated by seats which do not have much resilience.

In general, the design of an armchair or couch should ensure that the spine is kept in its normal shape with minimum pressure on the vertebral discs and the greatest possible relaxation of the back muscles. Research* has shown that seating should have a backrest with a convex lumbar pad, the main supporting

point of this pad being 80-140 mm. vertically above the occupied seat. The seat should have a backward tilt to prevent forward sliding and the angle of the backrest and seat should be between 105°and 110°. Armchairs should be well upholstered to distribute the bodyweight over a large area of the buttocks but should not be over soft or the support will be lost.

* The following dimensions are recommended for general use in upholstery:

Height of Seat	:	380 - 410 mm.
Depth of Seat	:	420 - 470 mm
Slope of Seat	:	20° - 25°
Angle between seat and backrest	:	105° - 110°

A major problem which affects the design of upholstery generally is the couch-bed (sofa-cama) or studio couch action currently in use. While its mechanical function is satisfactory, its overall size and proportions are such that the design of the couch itself is inevitably uncomfortable when sitting in a normal position. Since the accompanying armchairs have always to be designed to match the couch bed, they too become equally uncomfortable and unsightly.

In view of the above the following amendments are suggested which would enable improvements to be made in the design of the model.

a) Change the couch-bed action, or amend its present structure to allow for a greater degree of comfort and visual attraction as seating elements.

b) Design the elements as a range of comfortable seating units and then design the couch-bed as an alternative additional item with related features which associate it with the whole range.

* Society of Industrial Artist and Designers; Furniture Industry Research Association, United Kingdom.

Improvement in the softness of seats and backrests is recommended for the United States market, This is achieved by the use of lower density polyether or rubber foams or a layer of polyester fibre (e.g. dacron) of between 5% and 10% around the foam. This would provide for a much improved level of comfort.

5) Upholstery Fabrics:

Many of the upholstery covers being used at present are plain, almost coarse in texture, The colours and patterns are dull and un-exciting and their selection seems to indicate little research into the supply of more visually attractive fabrics. Even lower-priced fabrics for the less expensive ranges could be improved in their appearence by the choice of better colours alone. Small variations in the warp and weft of weaving would, for example, introduce more surface interest and improve considerably the overall appearence of the end-products. Such fabrics would also help to further the development of simple slab-type unit seating based on the use of particle-board or square section solid wood framing. Highly patterened fabrics should at all costs be avoided. They are difficult to "match up" in the various parts of the chair (viz. seats, arms, backs, cushions), pose unnecessary upholstery production problems and inevitably add to costs.

6) Corpus (panel-based) furniture:

This includes livingroom, diningroom, bedroom and kitchen storage units which are based largely on the classical or reproduction motif (e.g. Queen Anne and Regency styles). There is one range of modern units manufactured from melamine-faced and edge-banded particle board (California) and a range of office desking made from veneered particle board.

In general it may be said that they fulfill adequately their usefulness or fitness for purpose requirements. An exception, however, is the design of the dressing-table which nowadays is usually used for the storage of cosmetics, jewellery accessories and for make-up. Better drawer provision should be made for these items and the addition of a kneehole which would enable the user to sit in to the table and thus draw closer to the mirror would be a distinct advantage.

The kitchen storage furniture requires further development so that it may provide not only for the new kitchen market but even more importantly, for the replacement kitchen market. This is because increasing difficulties in obtaining domestic help will require housewives to pay more attention to the design of their kitchens and to the use of more labour-saving equipment e.g. washing machines, dishwashers etc. The development referred to related to the design on a modular basis for fixed units (floor and wall) and free-standing units. The basic dimension is a width of 533 mm (21") and a working height equivalent to the standard height of the kitchen equipment referred to and enables production of individual units in multiples of 533mm, 1066 mm and 1599 mm. This, in turn, enables the maximum use of standard parts, including doors, shelving and drawers, for a wide combination on units. Individuality in respect of design for kitchen furniture will come from door and drawer front treatment (melamine-faced, veneered and panelled), work-top treatment and the provision for all types of food and utensil storage. The fitting of kitchens in the replacement market will require the addition of "spacers" i.e. multi-width filling pieces to make up for any shortfall overall in width occasioned by the use of such modules.

The usefulness and saleability especially of living-room corpus furniture could be further extended by providing for television, stereo and recording equipment, videos and home computers in the design of the units. These items are becoming an essential part of life to-day and therefore need to be accommodated efficiently and tastefully by the manufacturer. Consideration should also be given to the design and marketing of ranges of students and children's furniture based on particle-board production and incorporating containers for some or all of the above mentioned equipment.

A final point with regard to function concerns dining table heights. Many of the Artepractico models and for that matter, those manufactured elsewhere in Ecuador were found to be too high for sitting at and eating comfortably. If the comfortable dining/working chair is between 400 - 450 mm. the table top should be between 710 -750 mm. maximum.

7) Recommendations for future design programmes:

a) General.-

1. To use more of the best available timber species in corpus furniture.
2. To exploit the use of the solid wood content by expressing its character in more detailed mouldings around frames and on solid edge-lipped panels.
3. To soften all exposed edged by using a good radius - something which is impossible to achieve with edge-banded particle board.
4. To improve sanding, staining and finishing techniques and to achieve a smoother feel and richer look in both the veneered and solid wood areas in keeping with the fine nature of such materials.
5. To introduce warmer colours in the selection of all fabrics for chairs and upholstery items.
6. To improve the comfort of all chairs and upholstered units. Care will be needed in selecting foam cushioning and fabrics in order to comply with the relevant fire regulations. This is particularly important for exports.
7. To provide a wider choice of chairs to complement corpus living and diningroom furniture. Each chair frame should be capable of having three different backs thereby effectively altering its appearence e.g. upholstered panel, vertical back rails, horizontal back rails.
8. To provide a selection of tables to suit varying needs such as gate-leg, drop leaf,extension flip-over, drawleaf extension etc.
9. To design wherever possible for greater versatility in use.
10. To increase the number of occasional items e.g. wine tables, lamp tables, nests of tables, T.V., computer and Hi-Fi units, writing units, corner cupboards, connecting elements etc.
11. To establish two main design objectives namely "Classical" and "Modern".

b) Classical:

This styling has the greatest potential especially in the United States market and could also be developed with success in the domestic market.

It is achieved by careful and detailed research by both design and marketing departments into European and American historical furniture periods. In choosing a particular period, consideration should be given to the wood species in reasonable supply in Ecuador, especially those which lend themselves to fine detailing and colour by staining. Such species which readily spring to mind in this respect include Fernan Sanchez (triplaris guayaquilensis), cedro (cedrela adorata), laurel (cordia Alliadora), sangre de gallina (visma abstusa), pino (pinus radiata) and cuangare (dialyanthera gracilipes). It would therefore appear that a style from the early 18th to the mid 19th century could be adopted and appropriately adapted by clever design to produce an entirely Ecuador /Artepractico image with distinct "classical" characteristics.

Once such a theme has been developed a whole series of ranges could be based on it and thus provide continuity both in design and manufacture. This identifiable theme could also be adapted for the domestic market.

With regard to upholstery, th "classical" look is not so vital, its main requirement being to be comfortable and restful. The theme, however should not be lost and one significan method of maintaining it is by the pattern/texture and colour of the covering fabrics. These fabrics may even be specially designed to relate to the design features and scale of the corpus furniture.

The exception to this is show-wood frame upholstery where the design motifs can identify with other furniture within the range by using similar ornamentation e.g. mouldings and leg details.

c) Modern

In general it may be said that penetration of the U. S. market for modern furniture is not as easy as for classical type furniture. This is because of long established competition from, in particular, European and S.E. Asian manufactures and a flourishing domestic manufacturing scene in the United States itself. Careful attention, therefore, will need to be made to the marketing implications before a comprehensive design brief is prepared and implemented.

Artepractico is already producing some modern furniture including kitchen units for the home market. None of the models concerned, however, could be said to be fully developed in the context of design integration and give the impression of having been produced individually on an ad - hoc basis and without due reference to how each would fit in to the Artepractico "family" of models.

There is undoubtely plenty of scope for worthwhile sales penetration on the domestic market for modern corpus furniture as evidenced by consumer reaction to the California range. However, it needs to be further developed both functionally and aesthetically in order to provide the versatility, usefulness and attractiveness which must be inherent in this type of furniture. A number of ranges could be based on this theme with particular attention paid to the incorporation of solid wood elements (e.g. doors, drawers and edge treatment) which are well proportioned and have variations in panel and handle treatment.

8) Summary of Main Product Characteristic Requirements:

a) Corpus Furniture:

1. Melamine-faced or veneered particle-board.
2. Edge-banded with coloured or wood-imitation veneer or real wood veneer.
3. Solid-wood edge-lipping which may be moulded.
4. Modular system incorporating standard components with a wide degree of interchangeability.
5. Loose and fixed shelving. Glass shelving.
6. Completely or partly knock-down(K.D.) using appropriate jointing system and fittings.
7. Drawer-fronts and door fronts may be :
   a) Melamine-finished or wood veneered with appropriate edge-banding;
   b) Veneered, solid-edge lipped and moulded;
   c) Framed and panelled with panel variation.
8. Fitted with appropriate trim for display, writing, drinks, books, etc.
9. Capable of accommodating TV, Hi-fi, Video home computer and kitchen equipment.
10. Packaged and shipped in pack-flat form.

11. Capable of "self-assembly" (S.A.)
12. Correct particle-board specification/standard.
13. Carefully selected handles, hinges, locks shelf-supports, etc.
14. Special drawer-side sections (plastic-coated particle-board).
15. Having "add to" capability.
16. Finish in accordance with market requirements.
17. Modern or classical treatment.
18. De-luxe and standard ranges.
19. Related occasional furniture e.g. coffe-tables, drinks trolleys, nests of tables etc., using same theme.
20. Including self-assembly instructions

b) Solid Wood Furniture:

1. Suitable wood species dried down to an appropriate moisture-content level.
2. Parts that are machined, jointed and sanded and are ready for assembly.
3. Incorporating moulding, turning and shaping.
4. Using K.D. and/or fixed construction where appropriate.
5. Wood bending and laminating if possible.
6. Wood carving and inlay if possible.
7. Elements which are ready for assembly using knock down (KD) fittings for this purpose.
8. Surface finish in accordance with export/domestic requirements.
9. Modern or classical treatment.

c) Upholstery:

1. Frames whenever possible to be made up as elements, (e.g. seats, arms and backs), upholstered individually and then finally assembled.
2. More emphasis on loose cushioning system rather than fixed cushioning.
3. Development of a range of show-wood seating of interchangeable elements with curved seat and back rails and loose reversible cushioning. Wide arm rests with upholstered pads.
4. Greater mobility and protection of floor coverings by affixing suitable castors or domes on the frame bases.
5. Use of a variety of springing systems including coil springs, spring units, jute and rubber webbing and diaphragm sheet support.

Annex V provides sketch illustrations of above.

9) Design Management and Planning:

Design in Artepractico is under the direction and control of production and in particular, of Mr. Germain Tondo, Operations Vice-President. Mr. Tondo is not a furniture designer but an engineer with very considerable experience in furniture production. He has had to undertake the design function because no one else suitable was available and has in this department ten design and product development personnel.

Procedures for design and product development commence with the preparation by Mr. Tondo of design sketches of the model or models that are based on considered market requirements. The sketches are then prototyped and when each model has been approved, it is passed on to the design draughting department. Here it is analysed from the various points of view of production (raw materials content, flow process, machine and cutter requirements, special production aids such as jigs and fixtures, costing) and scaled and full-sized detail drawings are prepared. When all of above are satisfactorily completed a small pilot batch is produced in the product development workshop and all the relevant details are fed into the computer. The completed models are then displayed in the show-rooms in order to measure customer reaction. A decision is then made whether or not to put the model concerned into full production. The time taken from the preparation of the design sketches to completion of the prototype is usually about two weeks, and is good design productivity.

This procedure is considerably at variance with that normally carried out by an experienced furniture designer or design team, but is understandable in the particular circumstances of Artepractico where professional design expertise is not present. It may also account for the absence of a continued flow of creative ideas and progressive, successful designs from the design studio. It is important to emphasise that the furniture designer takes responsibility not only for the visual design concept but must also be capable of taking into account and fully exploiting the marketing, engineering and economic aspects of the design brief. The latter must, therefore, be carefully prepared by the marketing department in conjunction with the designer so that he can prepare his design sketches accordingly. These are then submitted for consideration to a design committee made up of the President, his Vice-Presidents for Marketing and Operations and the designer. When this committee approves or amends the design sketches they are then prepared for prototyping and production.

This preparation includes the making of full-size working drawings indicating all the technical details required for production. Scale drawings (1:10) are also necessary in order to retain constant awareness of total proportion and detail. They are also a very useful adjunct to coloured sketches when mounting a presentation to marketing and other management. The designers should be encouraged to indulge in as much free sketching as possible as a better interchange of creative thought within the design team would lead to greater experimentation with design ideas. They are also useful in improving feedback and communication with marketing and production.

The full-size (1:1) drawings are passed on to the prototyping workshop and the prototype is prepared under the supervision of the design team. It may be found necessary to amend the model at this stage - usually only superficially, if the designers have done their job properly, - and such amendements are in-corporated into the drawings. The full-size drawing and the final prototype are then identical and the latter now becomes the final arbiter in respect of production technology and quality control. It is advisable to transfer the full-sized working drawing to plywood since it will be constantly referred to by product development and production. The original should be stored in a damp-proof cabinet suitable for the purpose which is located in the design studio. Product development and pilot batch production leading to serial production and all that that entails are then proceeded with. It should be stressed that the arrangements within Artepractico for these activities are among the best the consultant has ever encountered and need little, if any, amendment.

It is evident from the foregoing that the design function is best exercised when it is the creative link between marketing, which provides much of the design data and production, which supplies the appropriate technology. Consequently it should not be too closely allied with either so that it may more objectively interpret the established and progressive product policy of Artepractico. However, in practical terms it needs to identify more closely with marketing, the source of design ideas and may do so without in the least disrupting its essential connection with production. The consultant therefore recommends that the design department, including prototyping, should in future be under the direction of the marketing division. Product development will, however, continue to be the responsibility of production.

The design team in a factory the size and scope of Artepractico, should include at least one qualified and experienced full-time furniture designer who will establish and maintain the design function to the required professional standards and will train the design team accordingly. This expertise is not readily available in Ecuador and for the forseeable future the enterprise must depend on its importation from abroad. In order to initiate a new design programme based on the observations and recommendations made in the previous chapters on design, the consultant recommends as part of the current UNIDO technical assistance programme that a furniture design consultant of the appropriate calibre be recruited to carry out this important function. His draft job description is described in Annex IV and he should be made available as soon as possible. The company may subsequently consider retaining him on a more permanent basis.

Finally, the design team will best function in an environment that is conducive to the study, research and creativity essential to good design and design productivity. The studio should also be located alongside the prototype workshop so that there is a convenient and efficient interplay between design draughting and prototyping. It should be equipped with the usual draughting facilities and there should also be available to the designers a range of reference books, catalogues and other furniture trade literature related to all aspects of furniture design and technology. These recommended arrangements should be completed prior to the arrival of the proposed design consultant. A comprehensive list of appropriate furniture literature will be prepared during phase II of the technical assistance programme.

B. Raw Materials Supply.

Since raw materials can account for up to 45% of the cost of manufacture of furniture, their supply and efficient utilization are of paramount importance in both design and production. These materials include solid wood, board materials (plywood and particle board mainly) adhesives, stains and lacquers, fittings and accessories and upholstery materials.

1) Solid Wood:

Ecuador has fair supplies of solid wood which, in the main, are suited to furniture production. There are occasional problems regarding supply, mainly because of extraction difficulties at certain times of the year but these are being overcome by careful management of the supply situation. Species such as

Fernan Sanchez (triplaris guayaquilensis) is the most important and has the necessary structural and working characteristics for furniture-making. Unfortunately few of the species possess good or uniform surface grain marking and wide variations in colour and shading can occur in single components. This poses considerable problems during the surface coating operations, especially with staining and matching, which are not always overcome. Considerable additional care, therefore, in selecting and matching of components during the early stages of production is essential in order to minimise this problem and avoid consumer reaction.

The enterprise has good timber drying facilities which include 120 m3 pre-drying and 190 m3 kilning. Since this aspect of production will play a vital role in the development of exports especially of solid wood furniture and while there is no reason to state that it is not being carried out effectively at present, it is one which must be given close and continual supervision by management. Particular attention, therefore, should be paid to the following basic principles of wood drying:

1. Theory of radial, tangential and longitudinal shrinkage and movement of wood;
2. Calculation of percentage shrinkage and movement;
3. Calculation of percentage moisture content;
4. The effects of atmospheric humidity and temperature and moisture content of wood and the concept of equilibrium moisture content;
5. Methods of measuring moisture content;
6. Rates of drying different species and timber thicknesses;
7. Moisture contents requiered for different end uses and locations;
8. Selection and operation of suitable kiln-drying equipment
9. Air-drying, building and orientation of timber stacks.

It should be noted that moisture content values for wood used in the United States vary significantly according to geographical location, ranging from 11 % on the south-east and west coasts to 8 % in the mid-west and dropping to 6 % in the Rocky Mountains.

2) Board Materials (mainly particle-board)

Particle board is manufactured by Artepractico for its own furniture plant or for sale to other users in Ecuador and beyond. This is of two types , standard boards for panels surfaced with wood veneers, plastic laminates and other skin materials and milamine-surfaced boards using resin-impregnated papel foils so that no further surfacing treatment is required. Finishing may be in plain colours or imitation woodgrain and thicknesses vary from 4 to 25 mm.

The board is produced to the appropriate DIN* standards, is of good quality and seldom poses problem in furniture production. They can, however, arise in the particle board plant itself and relate in particular to the production of the particles, poor adhesive flow, uneven distribution of layers and as a consequence, difficulties in producing, in particular, 4 mm boards.

Most of these problems can be traced back to mechanical and electrical faults within the plant itself, partly because of unsatisfactory quality control and partly because of a lack of spare and replacement parts. This is a matter which should receive more attention from management now that a major export drive is under way. Also the technology and quality control aspects of particle board production should be included in the training programme envisaged for the fellowship in materials and production quality control recommended elsewhere in this report.

3) Surface Coating Materials:

The most important finishing system used by the plant is based on the use of nitrocellulose sealers and lacquers and accounts for about 80 % of production. This system has relatively low resistance to heat and to solvents spillage on it and there has been considerable negative consumer reaction to it.

In order to solve this problem the management is now using a combination of polyester and nitrocellulose and while the resultant finish is superior to that provided by the N.C. lacquer alone, it is proving to be expensive both in materials and labour. In addition, delamination tends to occur between top and under coats,

* DIN - Deutshe Industrie Normen

the repair of which can only be done effectively by stripping down to the base material and re-surfacing. This system also inhibits the use of the plant's fully automated lacquering facility much of which is occasionally idle. There are also problems in colour staining, matching and fading caused in part by the materials in use and also by poor selection of the wood species at the wood machining stage.

An acceptable alternative would be the use of polyurethane lacquers which combine flexibility and toughness with high resistance to damage by heat, solvents and mechanical effects. While the initial cost of using this material is somewhat higher than either nitrocellulose or polyester lacquers it is more than compensated for in economy of use. There are no problems experienced in the use of adhesives which include urea-formaldehyde hot melts and rubber-based contact adhesives.

4) Fittings and Accessories:

These include constructional fittings (usually associated with knock-down (KD) or self-assembly (SA) techniques. Handles, hinges, stays, locks and castors. They are particularly important especially for corpus production and their selection and use can enhance or inhibit the saleability of the end product as well as affecting its economic and efficient production.

Most of the fittings in use, especially handles and hinges are manufactured in Ecuador and are not of a particularly high standard. Others, which are used mainly in corpus or case-goods construction and trim are imported from suppliers in West Germany. The planned development of new design ranges of both solid wood and corpus production will occasion increased usage of the latter and further research into their suitability and supply is strongly recommended. Two such suppliers whose ranges of fittings and accessories for solid wood and panel-base production are particularly appropriate are:

SISO
1) 1, SKOVLYTOFTEN
DK-2840 HOLTE (COPENHAGEN)
DENMARK

2) HAFELE KG
P. O. 160
D7270 NAGOLD
WEST GERMAY

C) Manufacturing Facilities:

1) Buildings

These cover a total area of 47.075 m2 of which about 50 % is devoted to actual production and the remainder constitutes administration, raw material and finished goods storage and services. The various production storage and services departments are well and conveniently disposed and are ideally suited to modern production processing. Some 3.118 m2 are devoted to the intermediate storage of elements and components which are ready for assembly. This is an unusually large storage area for this function and again reflects on the current product and sales policy of the company. A recommended production and delivery period should not exceed six weeks which, if achieved, would reduce the need to devote such a large area to this purpose as well as esasing pressure on working capital, improving the cash flow situation and reducing storage costs. This, however, would depend on the production of highly rationalised ranges in optimum batch sizes.

2) Machinery and Equipment

The plant was designed and equipped for the production of a wide range of panel-based and solid wood furniture including upholstery. It therefore has solid wood veneer production, veneering, panel processing, assembly, finishing and upholstery sections which operate as a flow line based on roller conveyor. It incorporates a very wide range of modern processing equipment which is highly productive and well maintained. In addition, there are design and draughting facilities, prototyping, product development, timber drying, metalworking, machine set-up and maintenance quality control and general services. Planned capacity is about U.S. $. 10 Mill. but has already been indicated this has never so far been achieved.

The plant was clearly designed on the basis of highly rationalised product ranges to be produced in very large quantities, especially for panel-based furniture. To this extent a degree of inflexibility is apparent, which is difficult to reconcile with current or future domestic and export market requirements. This places a further responsibility on planning and production management to exercise re-sourcefulness and ingenuity in adapting this somewhat rigid and inflexible machine to the need to produce, not in accordance with stereotyped and un-imaginative standards but with the market and the customer very much in mind. Certainly the support facilities available especially for product development and engineering make this a reality if properly used.

D) Personnel:

1) Management (Production)

The most important determinant to the achievement of efficiency and profitability is the calibre, style and method of management. A high level of technology and professional knowledge is required at all levels, if the company is to operate successfully and produce furniture of the kind and quality demanded by the market and at a cost which allows for an acceptable profit.

At the managerial level the basic skill required is the ability to organise, control and make decisions without undue delay. This involves matters of product policy, finance and marketing as they are applied to daily routine matters of administration and production. Technical knowledge is also essential at this level to ensure that such problems are thoroughly understood and dealt with in a practical manner. Production management need not be experienced in financial management but they should have a working knowledge of the financial implications of operating a business of this nature especially costing and cost control, so that they can correctly judge efficiency and economy of choice of methods, materials and products.

Finally, the style of management should be co-operative. This form of management attempts to master the tasks set through mutual efforts by all

employees, bearing in mind their different levels of responsibility. It further acknowledges that any co-worker is an independant and grown-up individual.

Looked at in light of the above it may be said that the production management of Artepractico at its highest level has the qualifications, knowlecge and experience to manage this funct on effectively. The management systems and procedures which it has designed and implemented to ensure thorough programming and monitoring of all aspects of production, from incoming materials to finished products, could hardly be faulted. If anything, they could be described at over-elaborate but in every other respect they fulfill their function satisfactorily.

Why then it may asked does this not reflect itself in acceptable levels of productivity, which may be defined as the value of the yearly ex-factory sales per productive worker? Based on an exchange rate of 140 Sucres to the US Dollar, anticipated ex-factory sales for 1986 are approximately 6,8 million US Dollars. There are 410 direct workers in the plant including supervisors, which means that the average sales value per individual worker for 1986 will be U.S. $ 16.500. This may be compared with the productivity of similarly equipped factories in other parts of the world as follows*:

COUNTRY	PRODUCTION AVERAGE EFFICIENCY
	U.S. DOLLARS
Japan	60.000
Taiwan	30.000
Denmark	140.000
Italy	76.000
United Kingdom	92.000
France	96.000

The reasons for this situation in Artepractico are many and complex and relate in part to the establishment and history of the enterprise and its current financial, marketing and product policy status. All of these factors are now subject to an indepth re-organization and development programme, the outcome of which will it is hoped, eventually be reflected in a substantial increase in productivity.

* Source: The Furniture Industry in Western Europe-A statistical Digest.

However, this is not to say that considerable improvements cannot be made in the interim period, especially in the day-to-day running of the plant. Based on personal observations it would seem to the consultant that the production tempo in the plant is still too low. This can be accounted for to a considerable degree, by the absence of a highly rationalised production programme based on economic batch sizes and large series production, a condition for which the plant was originally designed. But it is not the entire reason and the very absence of a suitable production policy places an even greater onus, in the first place on top production management and subsequently at lower levels, to achieve the best possible production tempo in the circumstances. An added factor is an evident lack of industrial mindedness on the part of the production personnel, many of whom do not fully relate to the end product (it is not part of their lives) nor to how their particular function fits in to the whole chain of production.

All of these aspects must be taken into consideration by production management in devising a programme which will make the best possible use of all the resources, manpower, machines and materials, whatever their limitations. In the particular circumstances of Artepractico, this means above all else, effective and constant supervision and monitoring of production. It therefore must include supervision of the supervisors, a function which the production director can only carry out effectively by spending most of his time on the factory floor. If the production planning and target setting have been done correctly then this approach will present few difficulties and his very presence "in the driving seat," as it were, will provide the necessary added impetus.

What often keeps a production director seated at his desk is the welter of paper work which a bureaucratic approach to production obliges to come his way. Artepractico is no exception in this regard and their are many instances where for example decision making would be more immediately effective by direct word of mouth contact between manager and supervisor/operative. There is also the temptation for some to hide behind the paperscreen and to adopt the attitude that without it no action should be taken. This is how initiative, so vital to the future development of the enterprise, is destroyed. It should never be forgotten that

in any manufacturing set-up which is dependant on favourable market reaction for success, every worthwhile decision is a commercial one which sooner or later will affect the standing and viability of the company. No decision therefore which affects the smooth functioning of the plant should ever be unduly delayed.

It is evident that more attention to the training of the supervisors is necessary if they are to fulfill their roles effectively. They are in the front line of production and unless they are efficient in work planning, work standards, work allocation and human relations in addition to their technical know-how, the productivity levels will not increase substantially.

Production management must therefore ensure that it does not become remote from the factory floor and the production employees because of a variety of tasks and routine functions, many of which could be eliminated or delegated. On this point, there seems to be marked reluctance at all levels of production management to delegate responsibility and authority to lower levels. Perhaps as a consequence this is the reason that there is a marked reluctance among production personnel to accept responsibility for supervisory work. In both instances the solution to this problem lies with management. The consultant, during Phase II of the technical assistance programme, prepared a document on supervisory training which will later form the basis for a series of technical workshops on this subject (see annex V).

2) Labour:

The consultant is satisfied that notwithstanding the shortcomings referred to above the production personnel can be productive and can perform most operations to acceptable standards of quality and performance. To do this management must ensure that they are properly trained, supervised and motivated not least through a system of incentives that are achievable and rewarding. Production must be based on a system to which everyone works with only limited reliance on individual skills and judgements.

E. Organisation for Production.

The following is a break-down of the personnel engaged directly or indirectly in the production function:

I) DIRECT WORKERS

	Activity	Number Involved	
1.	Sawmill	17 (2 shifts)	
2.	Timber drying	7	
3.	Solid wood processing	46	
4.	Veneer production	12 (3 shifts)	
5.	Veneering	22	
6.	Panel processing	42	
7.	Assembly: Initial	32	
	Final	22	
8.	Sanding	64	
9.	Finishing	42	
10.	Upholstery	46	
11.	Metalworking	16	
12.	Auxiliary workshop	7	
13.	Controls: Processes	10	
	Quality	7	
14.	Packing	18	410

II) INDIRECT PERSONNEL:

15.	Product Design and Development (Template elaboration)	10	
16.	Prototyping	6	
17.	Production planning and control	13	
18.	Maintenance	27	
19.	Methods and time measurement	7	
20.	Costing and inventory controls	5	
21.	Dispatch	10	
22.	Raw materials storage	39	
23.	Finished goods storage	10	
24.	Supervision	24	151
			561

This indicates that within the production function, the ratio for direct to indirect personnel is almost 3 to 1. If extended to the total staff, the ratio is 1 to 2.2, a condition somewhat at variance with the norm for a furniture factory of this nature, i.e. for every 3 direct workers there is 1 indirect. In considering this, management should not loose sight of the fact that only direct workers add to value and the remainder to cost and that careful and continued assessment of the personnel function and performance is therefore essential.

Meanwhile comments are relevant in respect of some of the activities referred to above.

8. Sanding:

The number of workers in this section (64), in the light of overall production performance is excessive. Part of the reason for this is a shortage of equipment for mechanised sanding brought about by the shortage of working capital already referred to. A second reason is the amount of manual sanding necessary when using polyester lacquer as part of a finishing system. As soon as the situation permits, management should revert to mechanised sanding especially of mouldings which are seldom finished as satisfactorily by hand.

9. Surface Finishing:

As in the upholstery department, but to a greater extent, most of the products currently in production are neither designed nor manufactured to suit the installed finishing capacity which is in part-automated and semi-automated with excellent conveyorisation and drying tunnels. In the case of corpus or panelled-based furniture in particular this usually means finishing before rather than after assembly. This is not the prevailing practice in the plant and accounts for the very high labour content in this section. The usual ratio between the number of workers in assembly and those in finishing is 5 to 1. Here it is almost 1 to 1. Again design must play a vital role in resolving this situation.

10. Upholstery:

This is the least well-organised department in the factory but could be the most productive. Problems here relate mainly to product design which in its

current state does not lend itself to efficient production. For Artepractico, upholstery should be little more than an assembly plant based on "bought in" or "made up" components and elements e.g. frames, springing systems, cushioning and tailoring. This is the nature of modern upholstery production and is consistant with the manufacturing equipment available. Otherwise there is no justification for a staff of 46 in this department.

11) Metalworking:

This is an extremely well-equipped department with a capacity far in excess of Artperactico's metalworking needs. It should be re-constituted as a separate autonomous entity servicing, not only Artepractico, but also the metalworking needs of Cuenca and beyond.

12) Special Production and Repairs:

This is a very useful adjunct to standard production and allows for a degree of flexibility not easily obtained in the main plant. However it should be subjected to a similar degree of performance and accountability as the latter.

14) Product Design and Development:

As recommended in the chapter on design, the section of this department dealing directly with design should become part of the marketing division. The remainder should operate under the aegis of production planning which includes jig and former making. The design department should have one full-time furniture designer and not more than 2 furniture design draughtsmen.

16) Production Planning and Control:

This department has a staff of 13 which when joined to product development will increase to 23. This is a somewhat high number of persons for these functions, particularly in view of the fact that computerization is designed to eliminate manual processing of information and reduce staff numbers.

The activities of this department should therefore be reviewed with particular attention being devoted to job descriptions and performance standards. The most useful form of such a statement is one showing the main objectives of the job together with the key results which have the greatest effect in achieving these objectives and on the company's profitability. Details of how to devise suitable job descriptions have been provided and should be prepared by the personnel department.

19) Works Study:

The two main functions of this section are method study and time measurement. Again a personnel content of 7 seems excessive and the activities of the latter should again be subjected to a rigorous analysis to determine what is done by each individual works study engineer and how it relates to the efficient operation of the company.

23) Packing and Dispatch:

It is understood that this department's activities are currently under review by management. This is particularly appropriate in view of the company's imminent entry into export markets. Most items of furniture require some form of protective packing to ensure safe delivery to the customer. The hazards likely to cause damage vary in type and intensity depending on the method of transport and the design of the item being moved.

Attention is drawn to Furniture Packing Manual published by the Furniture Industry Research Association (FIRA), Manwell Road, Stevenage, Hertfordshire SGI 2 EW, England.

24) Storage:

The ideal situation in any manufacturing plant is to eliminate intermediate storage of components or elements awaiting assembly as well as storage of finished goods which would be shipped to the customer as soon as they are completed. This is not possible in furniture manufacturing with its multi-design and multi-process activity seen against a background of varying materials and varying machine capacity. Both types of storage however, add

considerably to cost and it should be part of the function of management to reduce dependance on each as much as possible.

In any event intermediate storage of components should not be accepted as an immutable fact of life and its effective control may be exercised by tracing back to and eliminating the various causes and effects which it will be found inevitably lead to design and marketing.

Storage of finished goods should be the responsibility of marketing and not of production. Once the furniture has passed final inspection; (also, a function of marketing) and is delivered to the warehouse the marketing takes over for the packing and delivery functions.

F. Quality Control.

The ability of a product to complete on a market is directly related to its overall quality and to a lack of variation in that quality. In the furniture industry there are very many sources of quality variations including the followings:

- Properties and conditions of timber and other materials;
- Dimensional accuracy of machined components;
- Dimensional accuracy of partly of fully assembled products;
- Quality of surface finishing;
- Durability and performance of finished products.

Control of quality implies comparing what is achieved with what is required, seeking the causes of any disparity and taking action. There are two main aspects of control of quality.

a) Regulating the process to maintain quality;
b) Adapting the process to achieve new and often higher levels of quality.

The most effective and economical approach is for the skilled workers to control their own quality and to inspect their own work. This is an expression of the management's ability to delegate, i.e. to define what quality is required and provide the conditions necessary for the worker to achieve this standard consistently.

The conditions are:

- the worker needs a clear definition of the quality to be achieved;
- the materials must be to the required specifications;
- the tools and equipment used must be capable of achieving the required quality;
- the worker must possess the necessary skills and ability;
- he must know whether or not he is achieving quality and, if not, be able to adjust the operation or process to achieve it;
- he must be motivated to achieve quality.

It is important to note that these conditions need to be satisfied at each stage of operation in the process whether the worker is machining, assembling, or polishing. Consistent failure to satisfy any one of these will mean that a chronic problem is present.

A strategy for quality improvement.

The principles and concepts outlined are basic and practical. Together they can form the basis for reviewing and upgrading quality in manufacture by considering the main areas of quality and testing the level of performance, the level of control, identifying the obstacles and defining the role of supervisors and craftsmen.

This approach spans all functions and in particular the following areas:

Quality standards - how they are defined and understood.

Supplier relations - control of incoming materials through reliable inspection.

Process capability - including factory capability, worker skills, control and motivation.

Management control - through product design and development, provision of appropriate equipment and skills, careful production planning, supervision, and communication.

Customer relations - through effective monitoring of customer reaction and customer needs. Quality is not absolute. It is comparative and part of the value judgement is made by the customer. Knowing where quality standard and performance stands relative to competitors is also necessary in order to improve quality of design and to adopt the manufacturing process to achieve it consistently.

The activities of the quality control department will be subject to a detailed analysis, including the preparation of quality specifications during Phase II of the current technical assistance programme. Meanwhile, in the light of the foregoing, it is evident that this department is operating in something of a twi-light zone with not too much notice being taken of its activities or findings. Part of the reason for this may be that since it is part of the production department, it cannot exercise a sufficient degree of objectivity in exercising the quality control function.

Ideally it should be part of marketing since, in effect, it is ensuring that customer reaction is positive leading to increased purchasing of the company's products. Since this is not possible in present circumstances, this department should report directly to the Executive President of the company so that due weight and appropriate follow-up action are given to its findings and recommendations.

G. Marketing for Export.

Progress is perceived in the re-organisation and development of the marketing department under the direction of its new Vice-President for Marketing, Mr. Hart Keeble. This includes the establishment of such functions as market research and assessment, product policy design and management, distribution and retailing aspects, competitor activity, forecasting, pricing and promotion.

Initial emphasis is being concentrated on the company's place and activities in the Ecuador market and later attention will be turned to export marketing, especially in the United States, the obvious target for the company. Little reminder is necessary that while on the one hand it is a highly lucrative market, on the other it is probably one of the most competitive in the

world. Consequently, only the highest degree of professionalism in the approach to this market is likely to permit, though not guarantee worthwhile market penetration. This professionalism extends from market analysis through every facet of the company's activities and results in the landing in the market-place of ranges of furniture which correspond to its requirements in every detail and ensure continued consumer satisfaction leading to further purchasing and buyer loyalty.

Export Procedures:

The successful export of furniture does not end with having saleable and competitively-priced merchandise. If the transhipment is not accompanied by supportive and trouble-free documentation and other procedures, especially at the point of departure, all other efforts way will be negatived.

1) Finance:

In this connection, it is essential that all financial implications concerned with trading are made clear to the importer from the outset, so that he can proceed with his subsequent trading arrangements sure in the knowledge that prices are firm and delivery will be as scheduled. Many importers will be doing business with Artepractico possibly for the first time and a good performance at that stage will create a lasting impression of satisfaction and be the best guarantee of continued good business.

2) Export Packaging:

Special attention should be given to export packaging to ensure that the furniture reaches its destination in perfect condition.

a) Edges and corners of all surfaces should be well protected with foam or other protective material.
b) All wrapping materials should be smooth and of a type which cannot harm surface finishes.
c) Cartons should be sufficiently strong and of a type which allow for re-shipment by the importer without re-packaging.
d) Packaging should be exactly in accordance with importer's instructions.

3) Documentation:

Proper documentation and prompt dispatch of all original documents is essential to efficient forwarding.

a) Original bills of lading, detailed packaging lists and customs invoices should be sent by registered mail immediately after shipment so as to arrive well in advance of the goods.

b) Careful attention should be given to the product description on all invoices such as the chief value of the materials used in the manufacture of the furniture (e.g. solid wood, upholstery matireals etc.).

H. Follow-Up Action.

The consultant recommends immediate follow-up action in the shape of further international technical assistance for Artepractico S.A. This should take the form of an integrated design and product development programme which takes account of the current ranges of furniture being produced by the enterprise and the need to replace or upgrade individual models in accordance with domestic and export market requirements.

The programme of consultancy should be result-oriented with clear-cut and unmistakable objectives being aimed at. The furniture ranges to be designed should be suitable for the chosen markets and should be capable of being produced efficiently and profitably in a manufacturing environment which has been structured for this purpose in respect of management capability, manufacturing facilities, production organization, quality standards and productivity. Actual market penetration should also be planned for initially through appropriate market investigation so that the right products are being developed and are subsequently being promoted through trade fair participation and direct contact through selected importers, distributors and retail sales outlets.

In tandem with the design consultancy programme there should also be a training component which would deal in a practical manner with the procedures related to all aspects of product design from preliminary sketches to serial production, including the involvement of senior marketing and production personnel. Special emphasis should be placed on market identification and evaluation, value analysis, cost reduction, quality standards and ergonomics.

Phase II of the current production and product development programme will include the installation and commissioning of test equipment for furniture materials and structures, the establishment of test procedures, the preparation of a manual on testing and quality control in general and the training of the quality control staff in all of the above. The consultant also proposes to held a one-day seminar/workshop for production supervisors aimed at improving their supervisory and production performance.

The two fellowships envisaged in the programme should be devoted to training in quality control and market orientation as follows:

1) Quality Control:

Objectives:

a) To become familiar with test facilities and testing procedures for materials and structures including timbers, board materials adhesives, upholstery fabrics, surface finishes, plastics, metals, fittings, composite boards, (especially particle board) foams, fillings and suspensions, packaging materials and the testing of complete items of furniture.

b) To investigate with the suppliers of the equipment recurring faults which have arisen in respect of particle-board production.

Location:

a) Preferably with the Furniture Industry Research Association (FIRA), Stevenage, England.
Period 3/4 weeks.

b) Milan, Italy
Period 1/2 week.

Commencement:

1st. September, 1986.

2) Market Orientation:

Objectives:

To enable the participant to visit the target market in order to gain first-hand experience of the market and its requirements, to establish personal relations with various prospective customers, to present products (through samples and catalogues) to obtain initial or sample orders and to explore the scope for technical and marketing co-operation.

Location:

Miami, High Point, Dallas, Los Angeles, San Francisco, Chicago and New York. Atlanta.

Period:

4 weeks.

Commencement:

As soon as possible.

A visit to the Cologne Furniture Fair in mid-January 1987. This fair is regarded as the one offering the best opportunity to meet U.S. buyers and to obtain information on the latest trends in furniture design.

Period:

1 week.

In the intervening period between Phases I and II the management of Artepractico agreed:

a) To implement as far as possible the recommendations contained in this report.

b) To complete the prototyping and product development of the following models, full-size working drawings of which have been provided by the consultant:
   1. Dining chair with three different backs;
   2. Contract chair suitable for restaurants, hotels and similar institutions;
   3. Range of integrated living-room storage units;
   4. Range of occasional items including tables, telephone tables. chest of drawers.

c) To prepare a draft quality control manual for production.

d) To prepare draft job description for all key production (direct and indirect) and administrative personnel.

e) To continue with its own re-organisation and development programme.

f) To follow-up contacts with U.S. importers which where established by the consultant.

All of the above have been or are being carried out satisfactorily.

III CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1) The Artepractico Furniture Factory is a well established and very well equipped plant capable of producing a wide variety of solid wood and panel-based furniture for domestic and export market.

2) The major problems facing the company at present are finance, marketing and design.

3) A new management structure has been established in the past year and the management is currently engaged in a re-organisation and development programme of the plant and its personnel.

4) While this programme responds realistically to Artepracticos' needs its ultimate success depends on the continued support of its major stockholder namely, the banks and other financial institutions.

5) The plant is currently operating well below capacity, a situation that cannot be satisfactorily resolved without the establishment of new ranges of furniture which correspond to market requirements, plant facilities and capabilities.

6) There are some difficulties concerning the supply of essential raw materials especially solid wood, veneer, finishing materials and fittings. These may be overcome by better purchasing management.

7) The ratio between direct workers and the remaining employees is very unbalanced. This is further exacerbated by low productivity.

8) There is a continuing need to analyse and evaluate the functions and performance of all those who are engaged in production support and monitoring services.

9) The executive management needs to get a firmer grip on costs in relation to personnel performance at all levels.

10) There is a need to upgrade the skills of the production supervisory staff so that they correspond to the developing needs of the plant in terms of performance and quality standards.

11) The training arrangements for operatives technicians and production management personnel need to be upgraded considerably.

12) Artepractico has until recently been almost totally production oriented rather than marketing oriented.

13) The marketing plans envisaged for the company are realistic and should be implemented as quickly as possible.

14) This applies in particular to exports without which the company is unlikely to reach its planned potential.

15) If the management accepts and implements the recommendations contained in this report there is little doubt that it can become strong and viable within the next five years and capable of winning its requir. share of domestic and export markets.

B. RECOMMENDATIONS

Design.

1) In order to assist in raising the general level of design in Artepractico, a furniture design consultant should be provided through the UNIDO technical assistance programme. Later, a full-time qualified furniture designer should be appointed.

2) The design consultant should establish an integrated and highly rationalised design programme consistent with export and domestic market requirements and the raw materials and manufacturing facilities available to Artepractico.

3) The resultant design ranges should have a distinctive and identifiable Artepractico image which distinguishes them from competitors products.

4) All the furniture should conform to accepted dimensional, anatomical, functional and quality standard requirements.

5) The design and prototyping departments should be included in the Marketing Division of Artepractico.

6) The design department should be re-located alongside the prototyping workshop.

7) It should be provided with a collection of reference books and other trade literature related to furniture design and technology.

8) Prototyping of new models should not be done until all full-size and scaled drawings are completed.

9) The UNIDO design consultant should train the Artepractico design staff in all aspects of furniture design and prototyping.

10) Artepractico should appoint a counterpart, preferably with an industrial design background, to work closely with the design consultant and to assume responsibility for design after the latter's departure.

11) Particular attention should be paid to the design of Artepractico catalogues and house-styling.

Raw Materials Supply.

12) Greater care should be exercised in the selection of timber species for particular design and production purposes. Species which are susceptible to insect attack and have pin-hole defects are not acceptable especially for exports.

13) The company should also endeavour to identify lesser-known Ecuadorean species that might also be suitable for furniture production.

14) Additional care should be taken to ensure that wood species destined for export furniture should be dried down to a suitable moisture content level.

15) The technology and quality control aspects of particle board production should be included in the proposed fellowship in quality control.

16) The polyurethane system of furniture finishing should be adopted in the plant and should, in time, replace all other finishing systems.

17) Further and more detailed research should be conducted in order to ensure the availability of the most suitable fittings and accessories for furniture production.

18) Those available from Ecuador sources are generally not satisfactory. If their quality cannot be improved then their use should be discontinued.

Manufacturing Facilities.

19) Storage areas of ready-to-assemble components and finished goods should be consistent with a production cycle and delivery period as close to six weeks as possible.

20) While production facilities are excellent, a greater degree of flexibility of production should be achieved by exercising more resourcefulness on the part of management in adapting machines for particular purposes.

Personnel.

21) Productivity, or the output value per direct worker per year should be increased significantly.

22) This can best be achieved initially by a more effective marketing and design policy leading to a more rationalised and efficient production policy.

23) The effectiveness of production and supervisory management should be increased by better production monitoring and especially by the continued presence of management in the various production areas.

24) Less emphasis should be placed on decision conveying by memo and more on word of mouth. Production and quality control decisions should not be delayed.

25) Supervisors should get further training in the various supervisory and production functions of their work.

26) The ratio between direct workers and the remainder of the staff is somewhat unbalanced and should be reddressed.

27) Many departments concerned with production appear to have personnel far in excess of their needs. This applies in particular to product design and development, production planning and computerisation, work study, surface finishing, storage, packing and dispatch. Their operation and manning should be further reviewed.

28) Storage of finished goods, final inspection,packing and delivery should be under the direction of the marketing department.

29) The functions and effectiveness of the quality control department should be further reviewed and upgraded.

30) This section should, for the forseeable future, report directly to the Executive President.

31) Appropriate industrial training programme should be established for all levels of personnel in the plant. This should begin by identifying training needs and then preparing training programmes accordingly.

32) All management and supervisory levels should have their activities reviewed in order to ensure that they are directly relevant to effective and profitable performance. This can best be achieved by revising their job descriptions, placing due emphasis on the key functions.

Marketing.

33) Apart from the immediate task of establishing an effective marketing and sales organisation, the marketing Vice President should also endeavour to ensure that the Artepractico plant and all its personnel become marketing and not just production-oriented.

34) In particular he should ensure that all relevant personnel should clearly understand the relationship between marketing, design, production and quality control.

35) Export marketing should initially concentrate on supplying importers/manufacturers in the United States with furniture manufactured in accordance with the latters designs and specifications.

36) Gradually and as further experience in exporting is obtained, this type of product should be replaced with distinctive, high quality, native designed furniture which incorporates all that is best in Artepractico's skills and materials but is, nevertheless, consistent with international marketing requirements.

37) Distribution arrangements should initially be in the hands of an experienced and knowledgeable importer/manufacturer who would also be prepared to assist in obtaining essential materials and equipment not currently available in Ecuador, possibly on a counter-trade basis.

38) In the longer-term Artepractico should set up its own import and distribution company in the United States.

Follow-Up Action

39) The management of Artepractico should implement as fully and as quickly as possible the recommendations contained in this report.

40) In assisting towards this end UNIDO should provide the proposed design consultant as soon as possible as well as implementing the recommendations regarding the fellowships in quality control and marketing.

ANNEX I

CONSULTANT'S JOB DESCRIPTION

SI/ECU/85/802/11-01/31.7.A

POST TITLE : Furniture Production Expert (Team Leader)

DURATION : Four (4) months

DATE REQUIRED : As soon as possible

DUTY STATION : Cuenca with possible travel in the country

PURPOSE OF PROJECT : To rehabilitate the Artepractico furniture factory through assistance in administrative/financial management, identification and development of an exportable product and design of an overall quality control plan.

DUTIES : The expert will be attached to the Artepractico furniture factory and will identify and develop the production and quality control systems of exportable furniture items. In particular he will be expected to:

1) In coordination with the management expert and the factory management identify the major characteristics of a range of furniture that can be produced in series for export.

2) Determine and/or select the appropriate production technology, tools, manpower and materials needed for its production in series.

3) Adapt the design for industrial production and produce prototypes of the products selected.

4) Modify to the extent necessary the existing production planning and control systems as well as quality control systems or develop and introduce new ones.

5) Assist in installing the equipment for the quality control laboratory and for testing the furniture and its components provided by the project and train counterpart staff in its operation.

6) Prepare a manual on the operation of the equipment in this laboratory.

7) Train counterparts in the above duties.

8) To the extent possible, carry out above activities in other factories.

9) Prepare a technical and a terminal report outlining the above and identifying actions to be taken by the management of the Artepractico furniture factory and others, the Government and possibly also international organizations to ensure as soon as possible, sound design, production and quality control practices in the factory.

QUALIFICATIONS : Wood technologist or engineer with considerable experience at policy making level in mass production of special furniture for export. Proven practical experience in product development, tool selection, process control, work organization, production management and overall supervision. Familiarity with and/or experience in developing countries an asset.

LANGUAGE : Spanish desirable, English acceptable.

ANNEX II

SENIOR MANAGEMENT OF ARTEPRACTICO S.A. AND OTHERS WHO CO-OPERATED WITH THE CONSULTANT.-

Mr.
FRANK HUTHNANCE
Executive President
Extension # 180

Economist
MIGUEL CARRASCO MOSCOSO
Financial Vice-President
Extension # 130

Mr.
HART KEEBLE
Marketing Vice-President
Extension # 198

Engineer
GERMAIN TONDO
Operations Vice-President
Extension # 185

Doctor
HUGO PESANTEZ
Head, Quality Control Laboratory
Extension# 129

Engineer
ORLANDO BAQUERO
Technical Director of Productions
Extension # 120

Mr.
HECTOR SALTOS
Industrial Relations Vice-President
Extension # 118

Doctor
RAFAEL SUAREZ
Chairman of the Board

ANNEX III

INDUSTRIAL PROFILE OF ARTEPRACTICO S.A.

1) ESTABLISHED : 1986

2) NEW PLANT : 1979. This incorporates sawnill, particle-board and furniture plants with a covered area of 70.000 m2. Manufacturing facilities for solid wood and corpus (panel-based) furniture production among the most up-to-date in Latin America.

3) NOMINAL CAPITAL : U.S. $ 10 millions

PRINCIPAL SHAREHOLDERS : Bank of America, Banco del Pacífico, Instituto Ecuatoriano de Seguridad Social (IESS), Corporación Financiera Nacional and Tosi Family.

4) EMPLOYEES : 874

5) ANNUAL SALES VOLUME : U.S. $ 6.8 millions (domestic market only)

6) PRODUCTION CAPACITY (furniture) : 200.000 units and 4.000 complete kitchens

7) PRODUCTION CAPACITY (Particle Board) : 30.000 m3 (4 shifts)

8) PRINCIPLE ECUADOREAN WOOD SPECIES USED (See Samples) :

Laurel	(Cordia Alliadora)
Cedro	(Cedrela Odorata)
Tillo	(Brosimun Alicastrum)
Pino	(Pinus Radiala)
Sangre de Gallina	(Visma Obstusa)

9) KILN-DRYING CAPACITY : 190 m3; monthly capacity 500 m3.

10) PRODUCTS : Wide range of traditional and modern solid wood and panel based (particle-board) furniture and upholstery, manufactured to own designs or in accordance with customers designs and specifications.

ANNEX IV

DRAFT JOB DESCRIPTION

SI/ECU/85/802/11-01/31.7.A

POST TITLE : Furniture Design Consultant

DURATION : Two months

DUTY STATION : Cuenca, Ecuador

DATE REQUIRED : As soon as possible

PURPOSE OF PROJECT : To establish a product design policy for the Artepractico furniture factory and to advise on the design and development of an integrated range of domestic and contract furniture for the Ecuador and selected export markets.

DUTIES : The consultant will be attached to the Artepractico furniture factory and will identify, design and develop ranges of styled and modern solid wood and panel-based furniture which are consistent with specific market requirements and can be produced efficiently and profitably in large volume by the factory. In particular he will be expected to:

1) In co-ordination with the marketing and design departments of the factory review and assess current design programmes.

2) Advise on a new integrated "product mix" based on target market and production requirements. And with an identifiable Artepractico image.

3) Eliminate unsuitable and unprofitable models.

4) Re-design remaining existing models where appropriate and introduce new ones on the following basis:

   a) To cover the chosen sectors of the domestic and export markets;

   b) To include living-room, dining-room, bedroom, kitchen, upholstery, office and occasional furniture requirements;

   c) To use, where possible, indigenous raw materials and advise on the selection and source of those which have to be imported.

d) To exploit fully the special skills and equipment available;

e) To design on a modular basis with a high degree of rationalisation and interchangeability of components;

f) To incorporate where appropriate knock-down (KD) and self-assembly (SA) techniques;

g) To be produced and sold within stated price ranges;

h) To establish product continuity so that customers can add to existing purchases in the future;

i) To ensure acceptable quality standards and specifications and in accordance with functional and ergonomic requirements;

j) To suit large-scale serial production.

5) Establish correct procedures for design management from the design breefing through prototyping to the stage where each model is developed for serial production.

6) Advise on graphics generally, the design and preparation of sales catalogues and other point of sale and promotional literature.

7) Participate in trade fairs and assist in establishing and maintaining contacts with trade and institutional buyers especially for exports.

8) Prepare a technical and terminal report outlining the above and identifying actions to be taken by management, the Government agency concerned and possibly also international organisations to ensure continuity of the new design programme.

QUALIFICATIONS : Internationally established furniture designer with considerable experience in the design and marketing of a wide range of solid wood, panel based and upholstered furniture for large-scale serial production and suitable for domestic and export markets.

Designing experience and knowledge of U.S. furniture market requirements essential.

LANGUAGE : Spanish desirable, English acceptable.

ANNEX V

Sketch illustrations of furniture models and ranges recommended as part of the new Aretepractico product policy.

Figure	1	Living-room range
"	2	Living-room range N° 2
"	3	Bedroom range
"	4	Alternate living-room units
"	5	Alternate bedroom units
"	6	Further development of bedroom units
"	7	Range of occasional items
"	8	Dining chairs (semi-reproduction style)
"	9	Dining chairs (modern styling)
"	10	Dining chairs (various back treatment)
"	11	Dining set (mainly 4-cutter work)
"	12	Dining table ideas
"	13	Occasional furniture (semi-reproduction)
"	14	Show-wood unit seating
"	15	Occasional furniture to match with 14
"	16	Show-wood upholstery units
"	17	Unit seating and matching sofa-bed
"	18	Classic/colonial style chairs

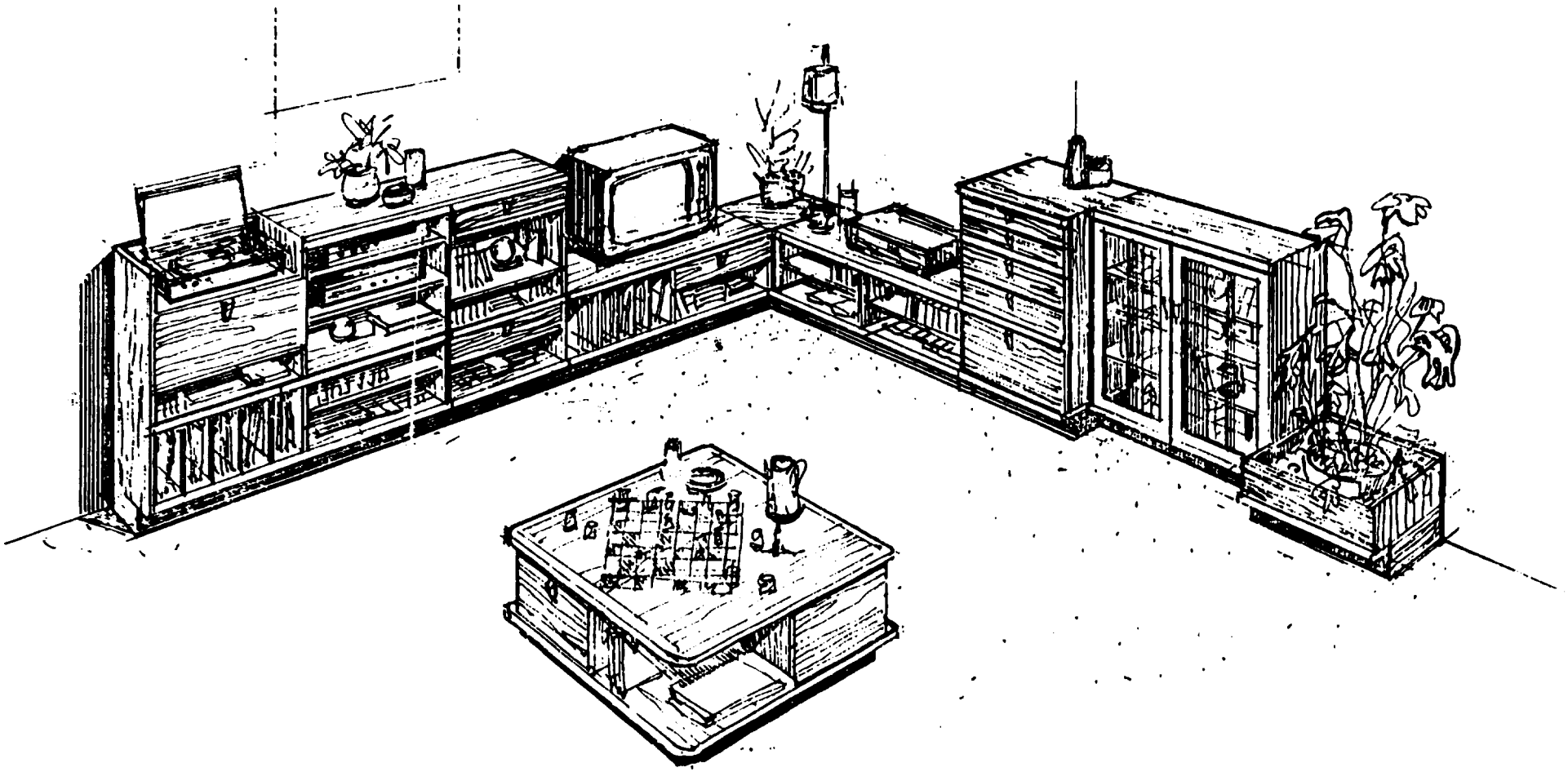


FIG. 1 LIVING - ROOM RANGE

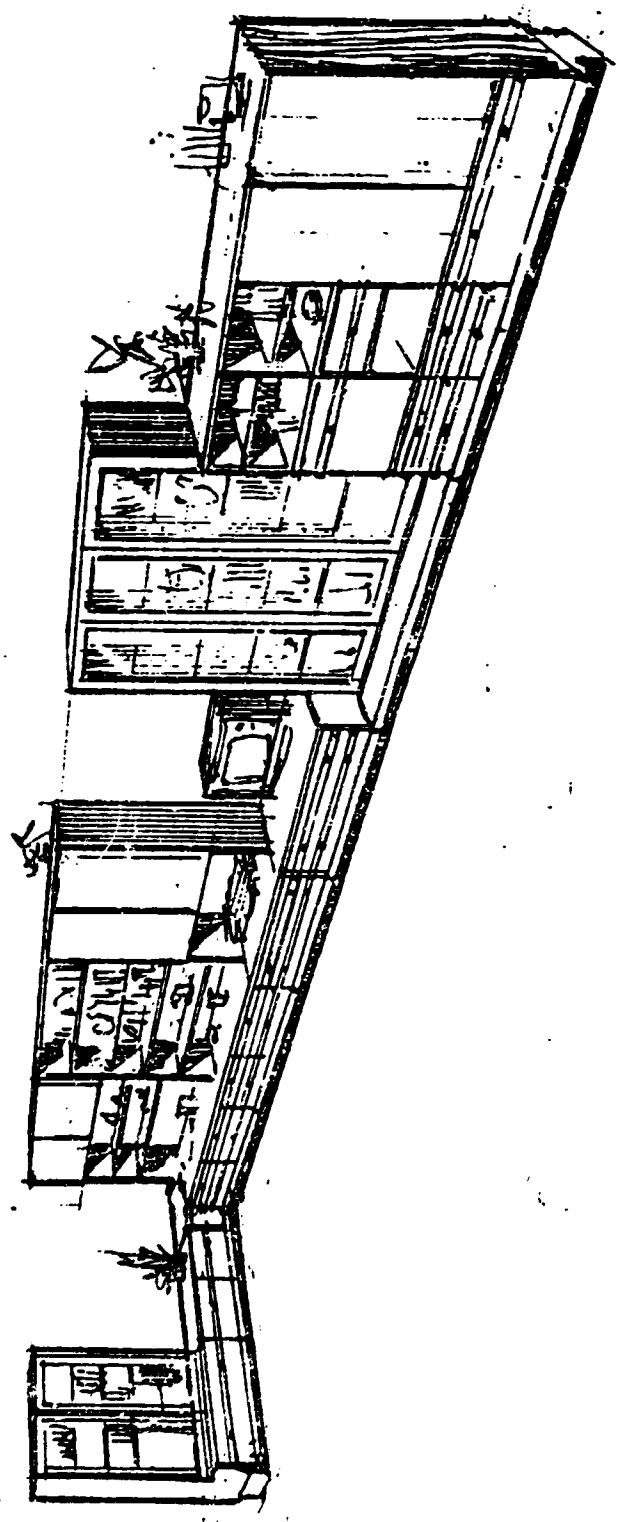


FIG. 2 LIVING - ROOM RANGE

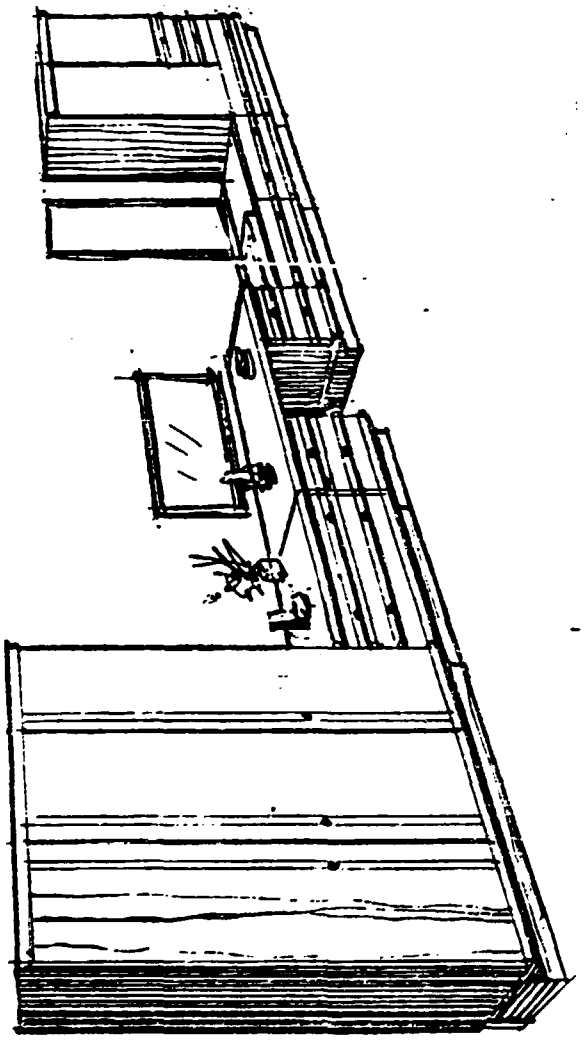


FIG. 3 BEDROOM RANGE

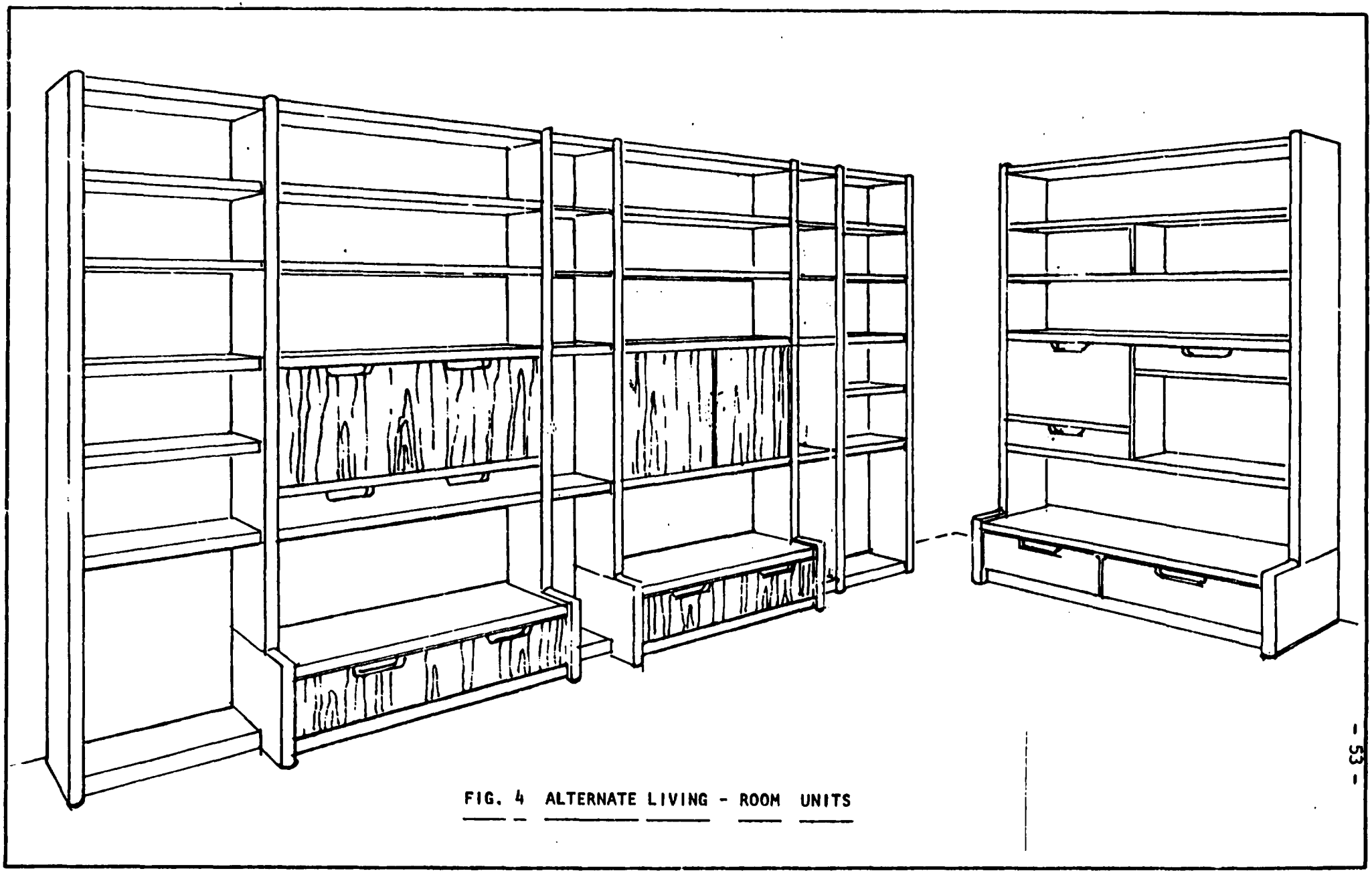


FIG. 4 ALTERNATE LIVING - ROOM UNITS

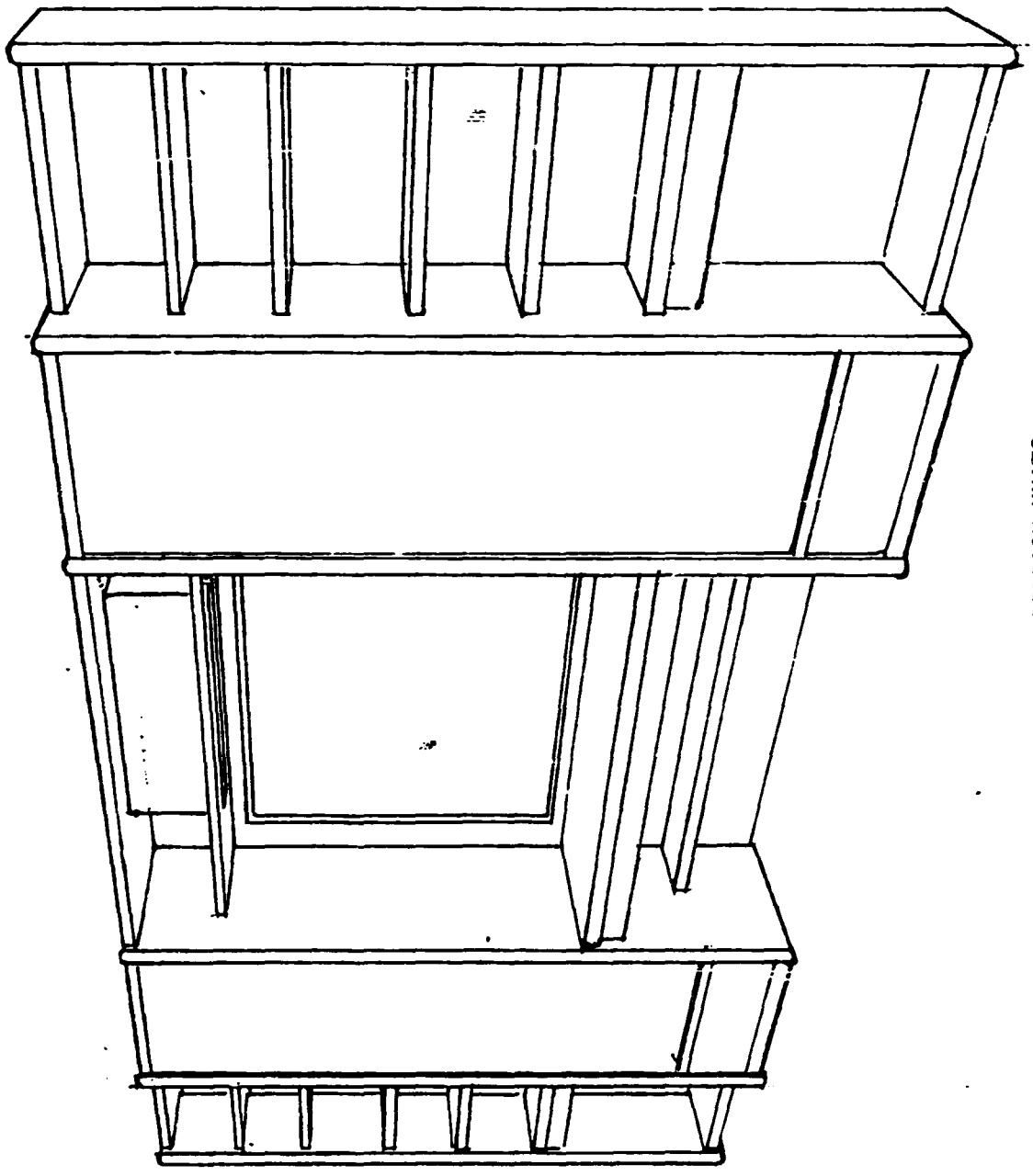


FIG. 5 ALTERNATE BEDROOM UNITS

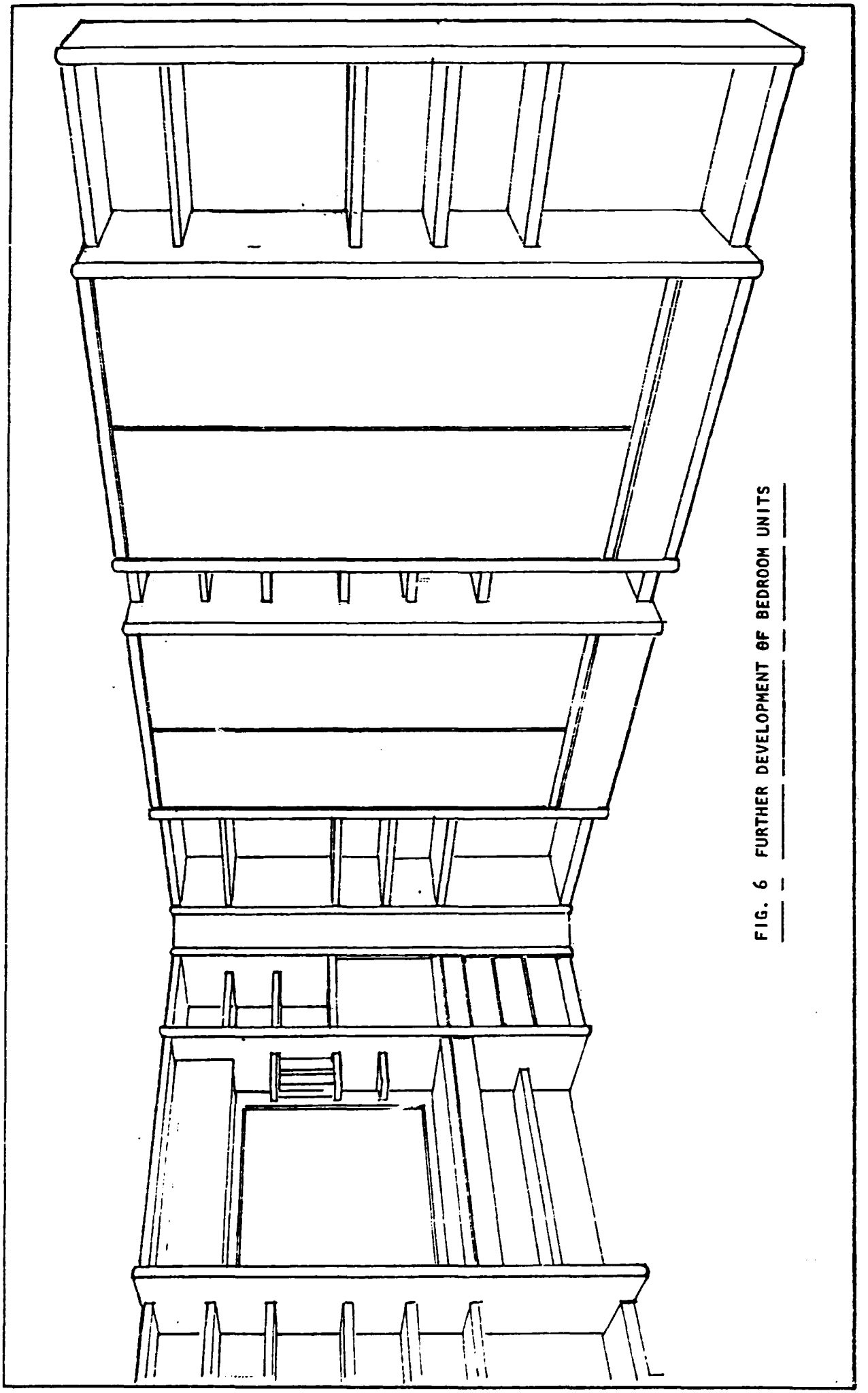


FIG. 6 FURTHER DEVELOPMENT OF BEDROOM UNITS

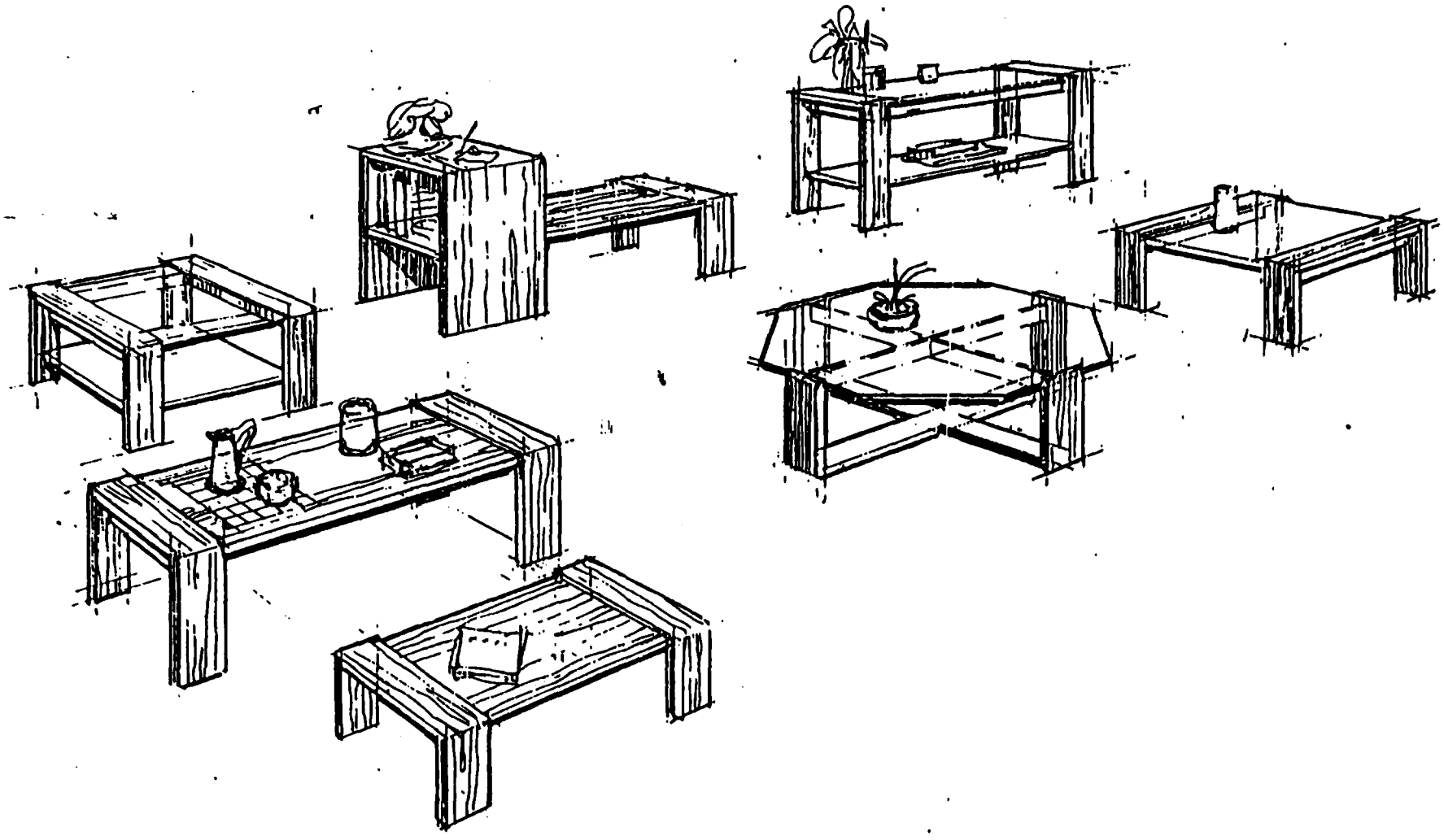


FIG. 7 RANGE OF OCCASIONAL ITEMS

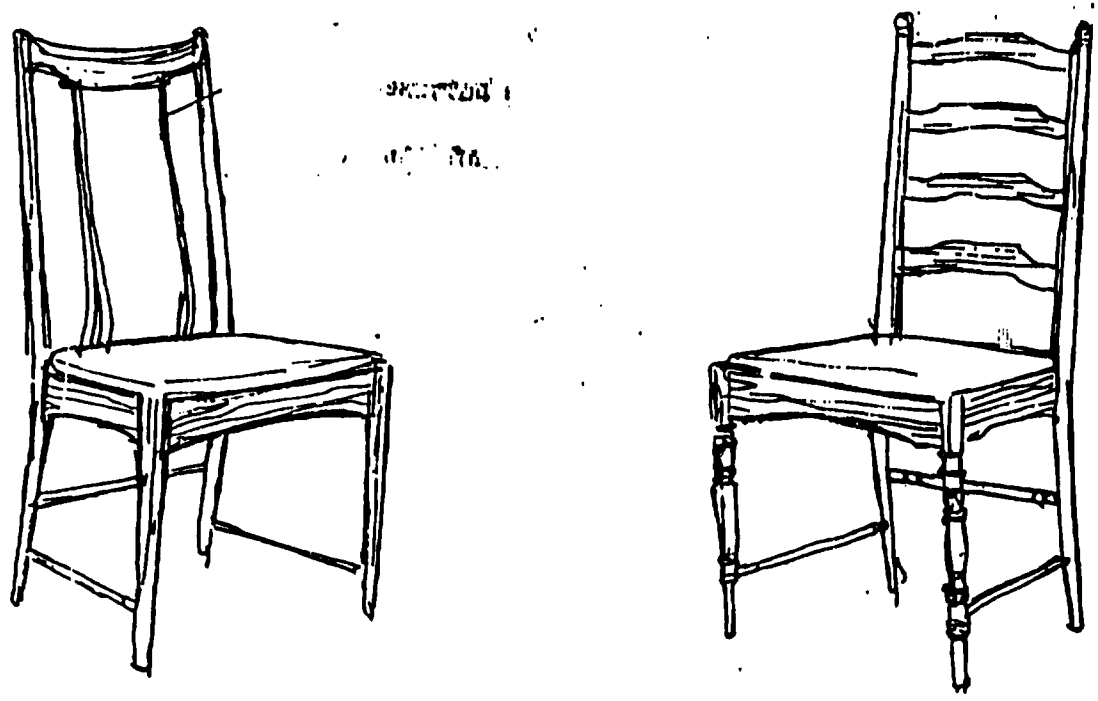


FIG. 8 DINING CHAIRS (SEMI - REPRODUCTION STYLE)

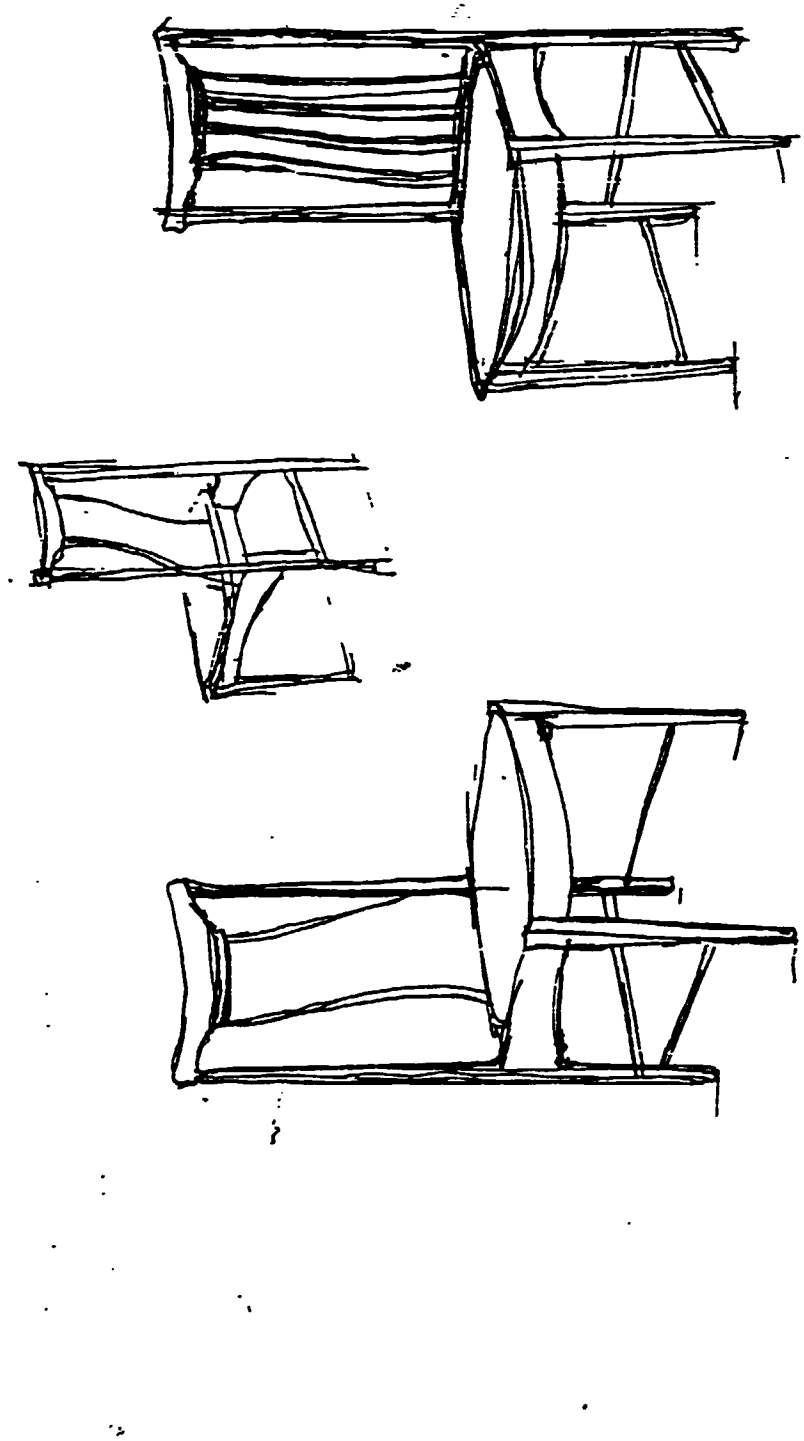


FIG. 9 DINING CHAIRS (MODERN STYLING)

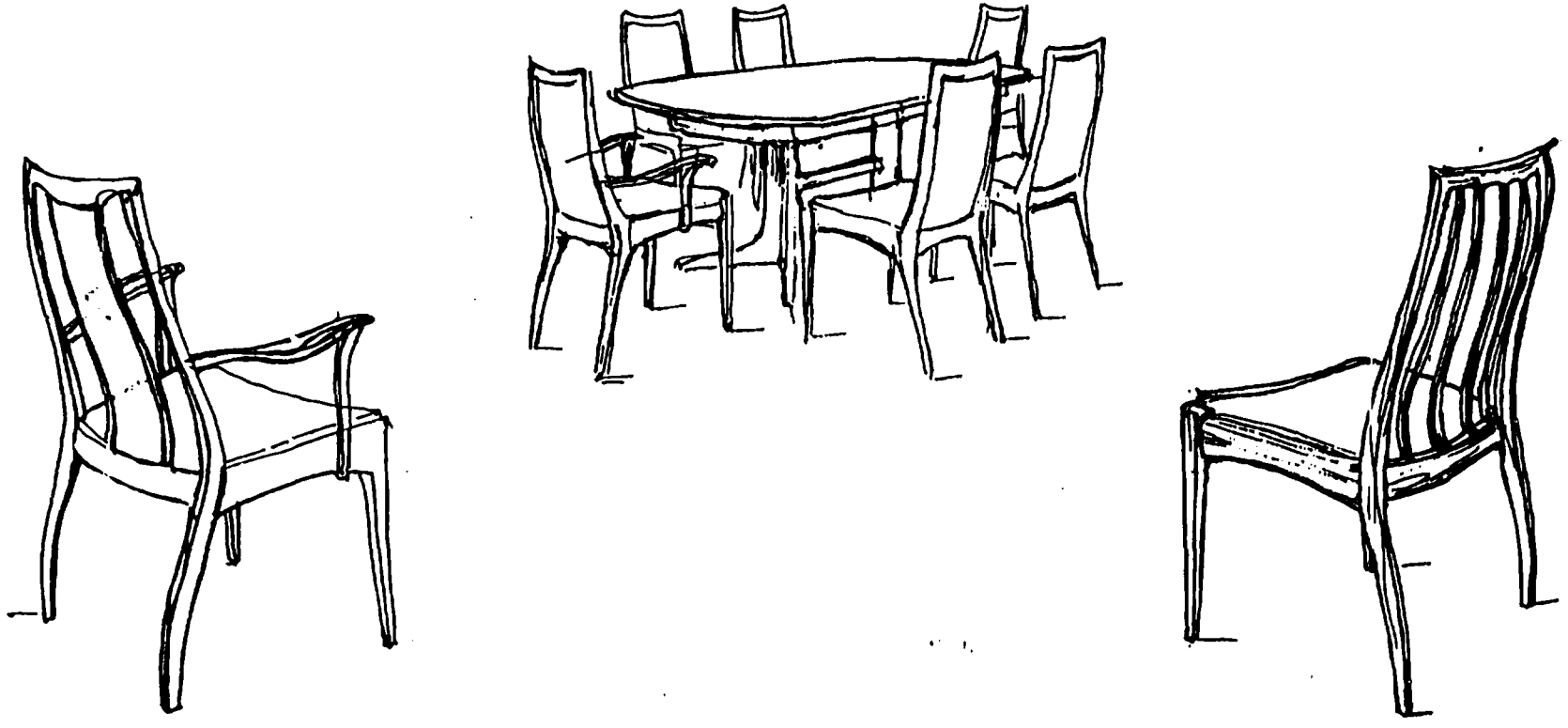


FIG. 10 DINING CHAIRS (VARIOUS BACK TREATMENT)

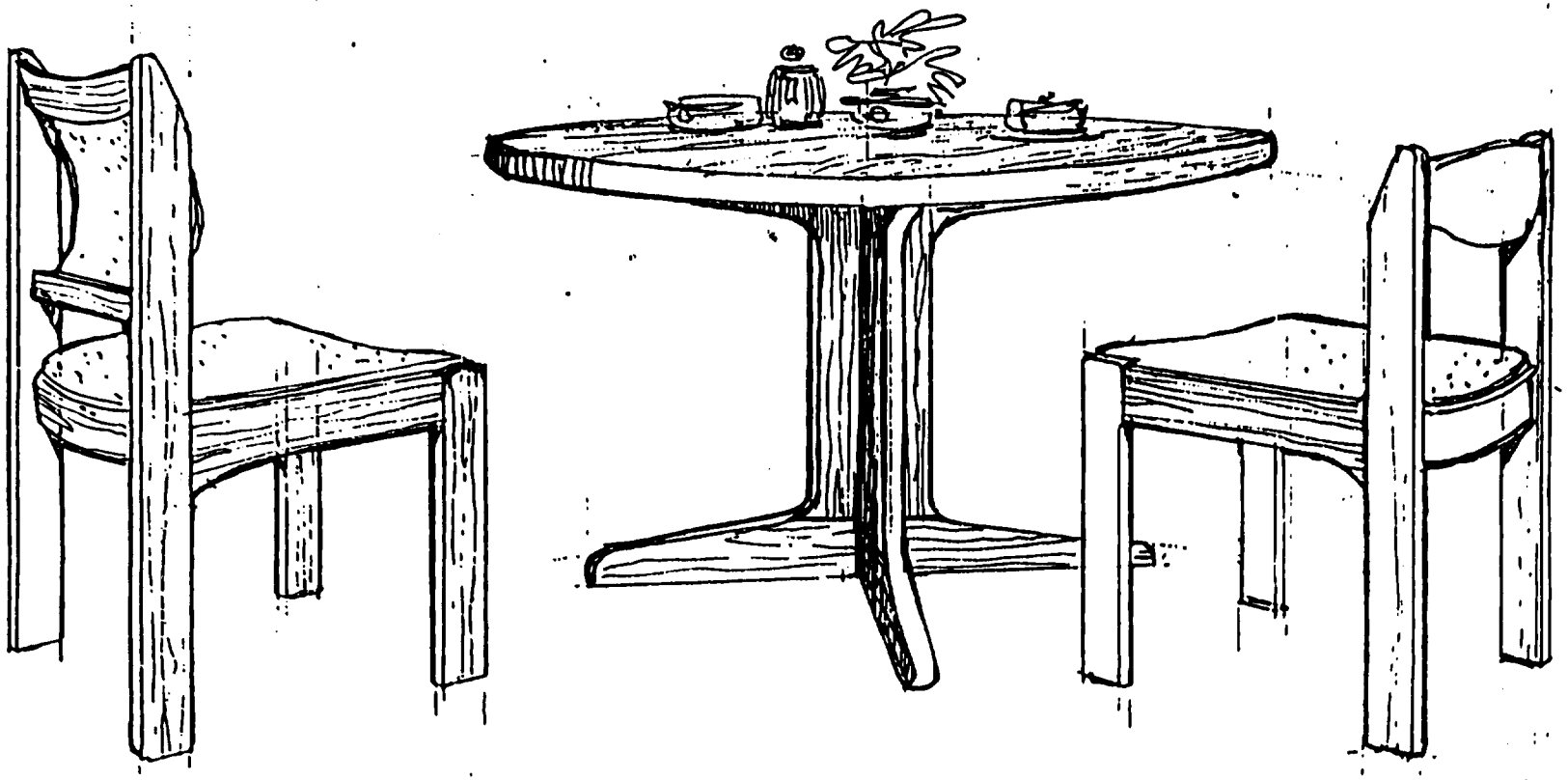


FIG. 11 DINING SET (MAINLY 4 - CUTTER WORK)

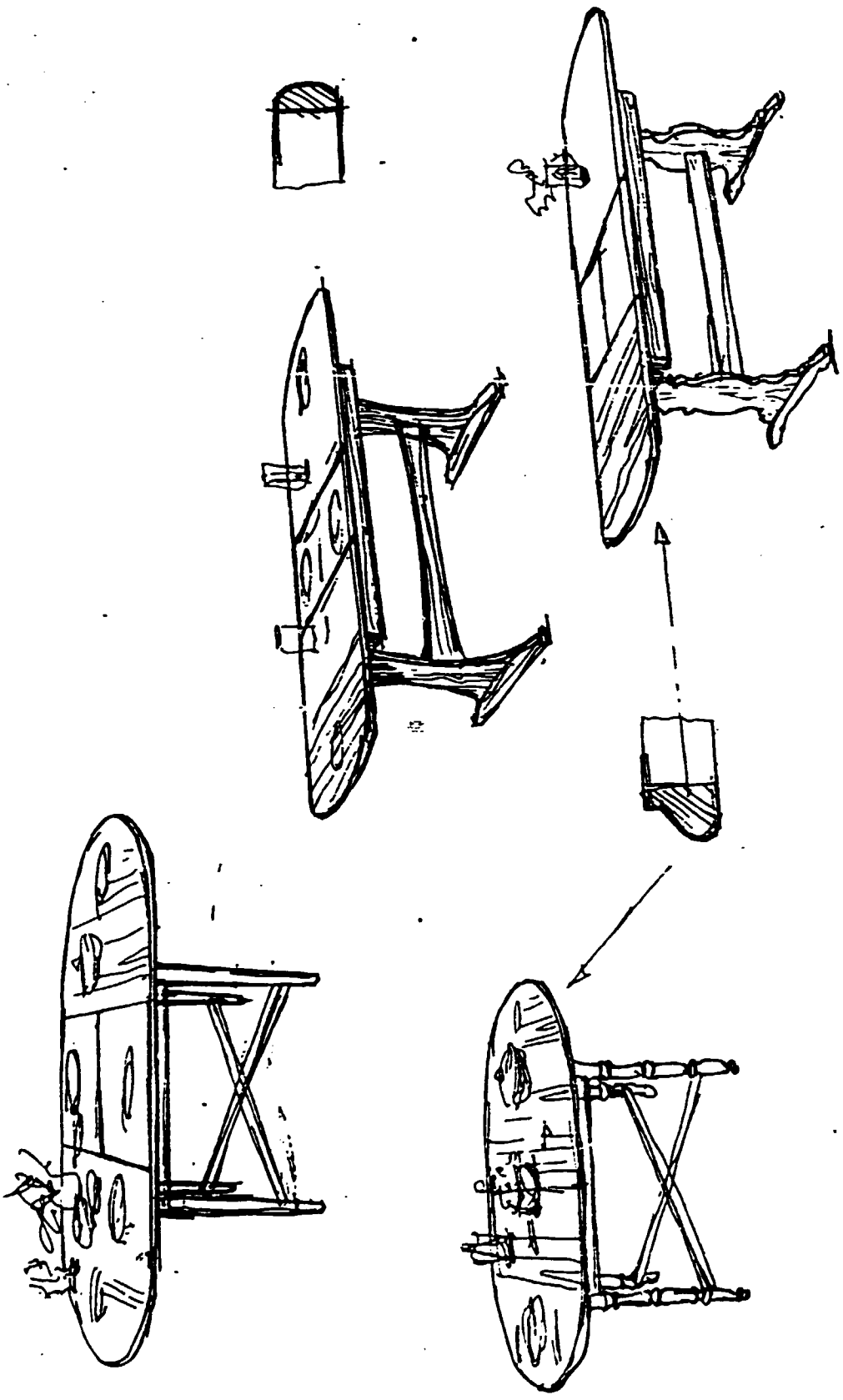


FIG. 12 DINING TABLE IDEAS

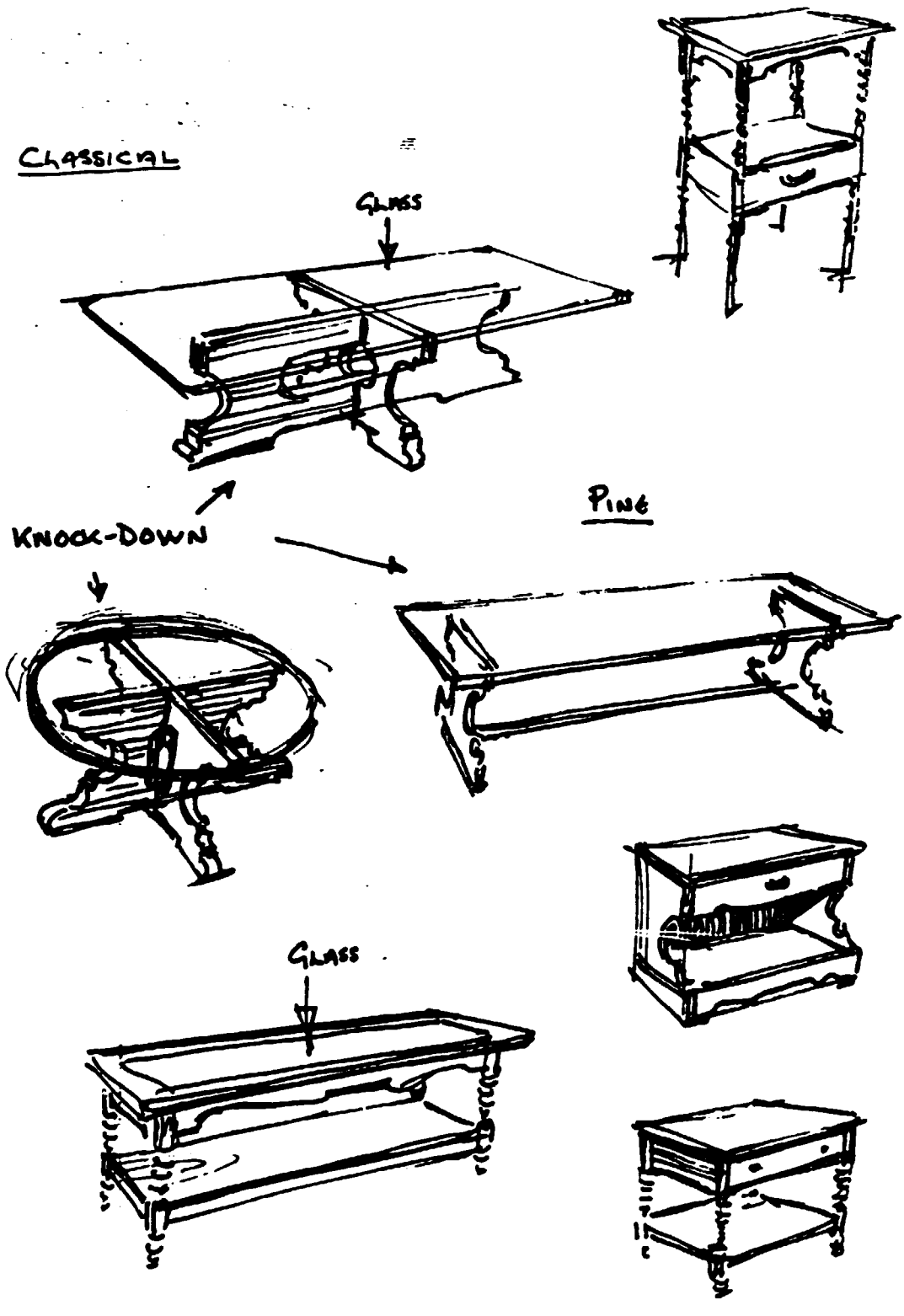
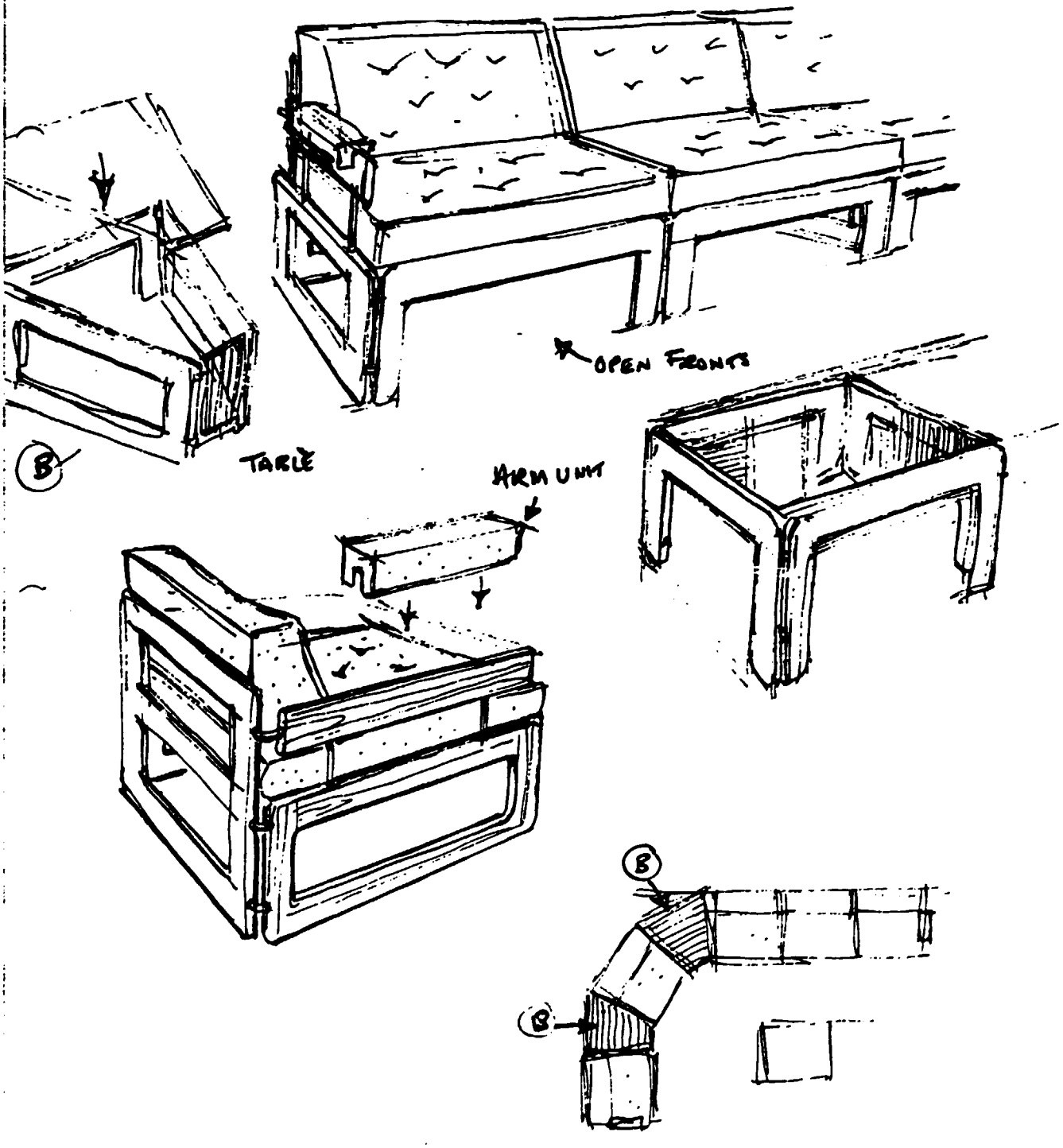


FIG. 13 OCCASIONAL FURNITURE (SEMI - REPRODUCTION)

FIG. 14 SHOW - WOOD UNIT SEATING



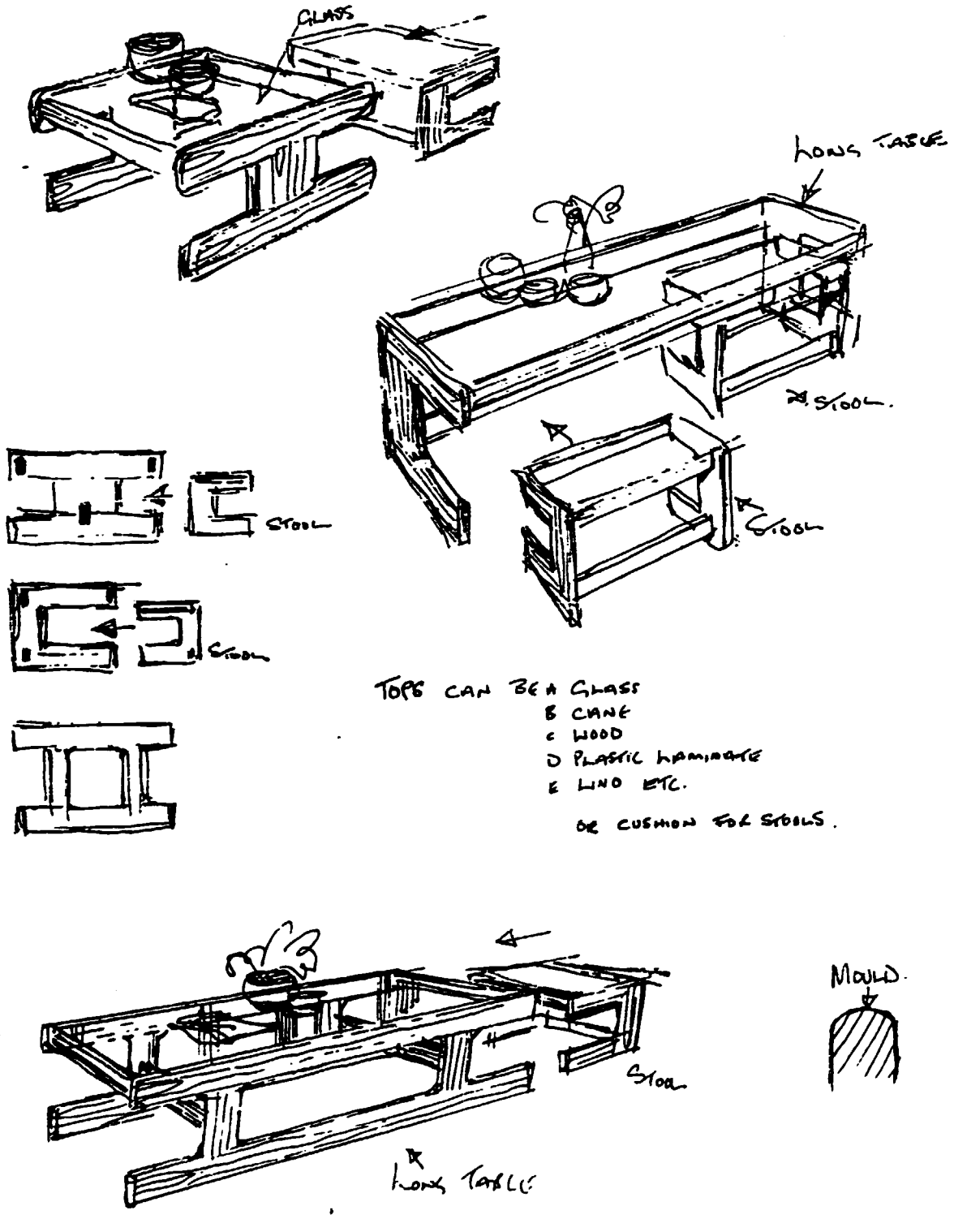


FIG. 15 OCCASIONAL FURNITURE TO MATCH WITH 14

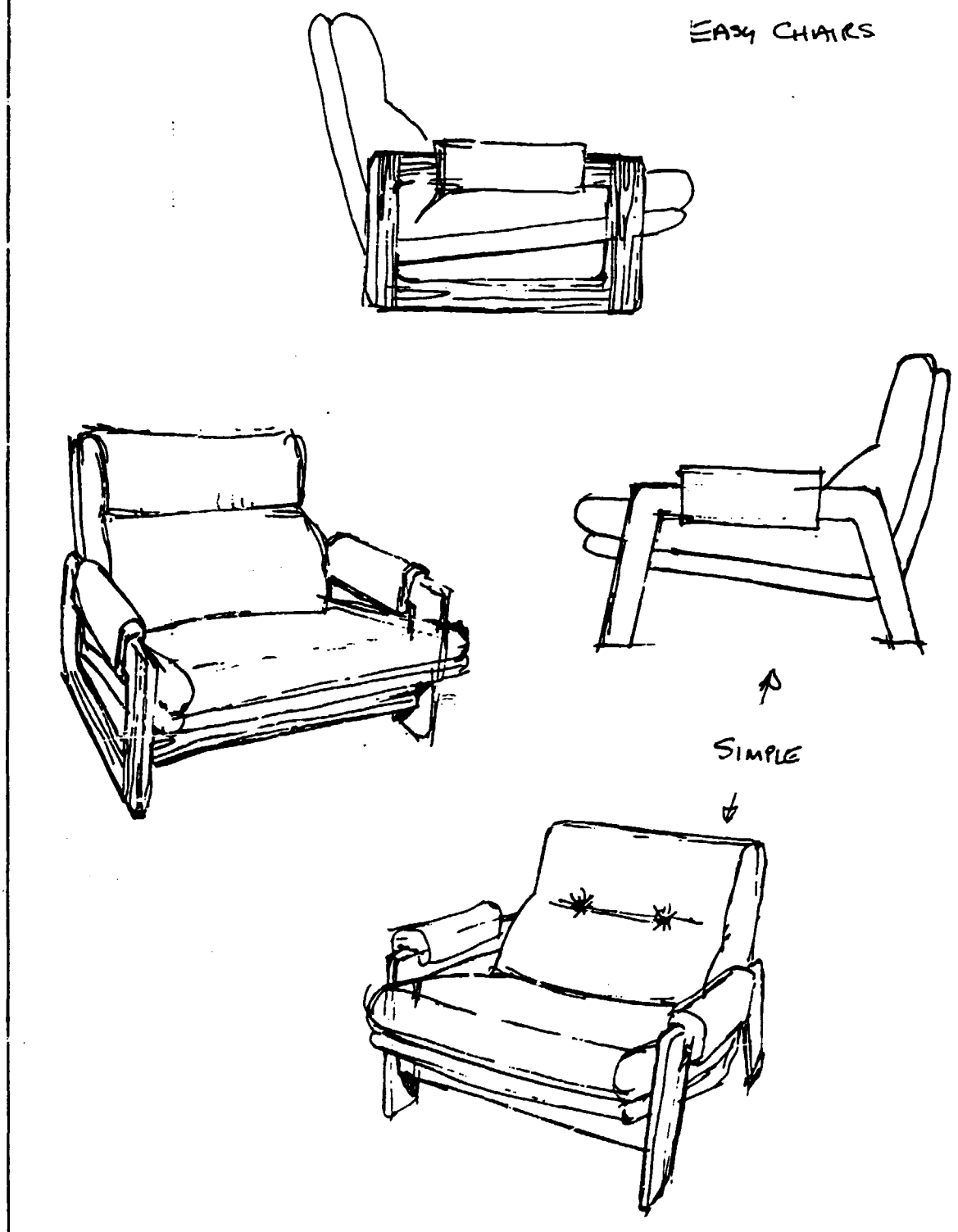
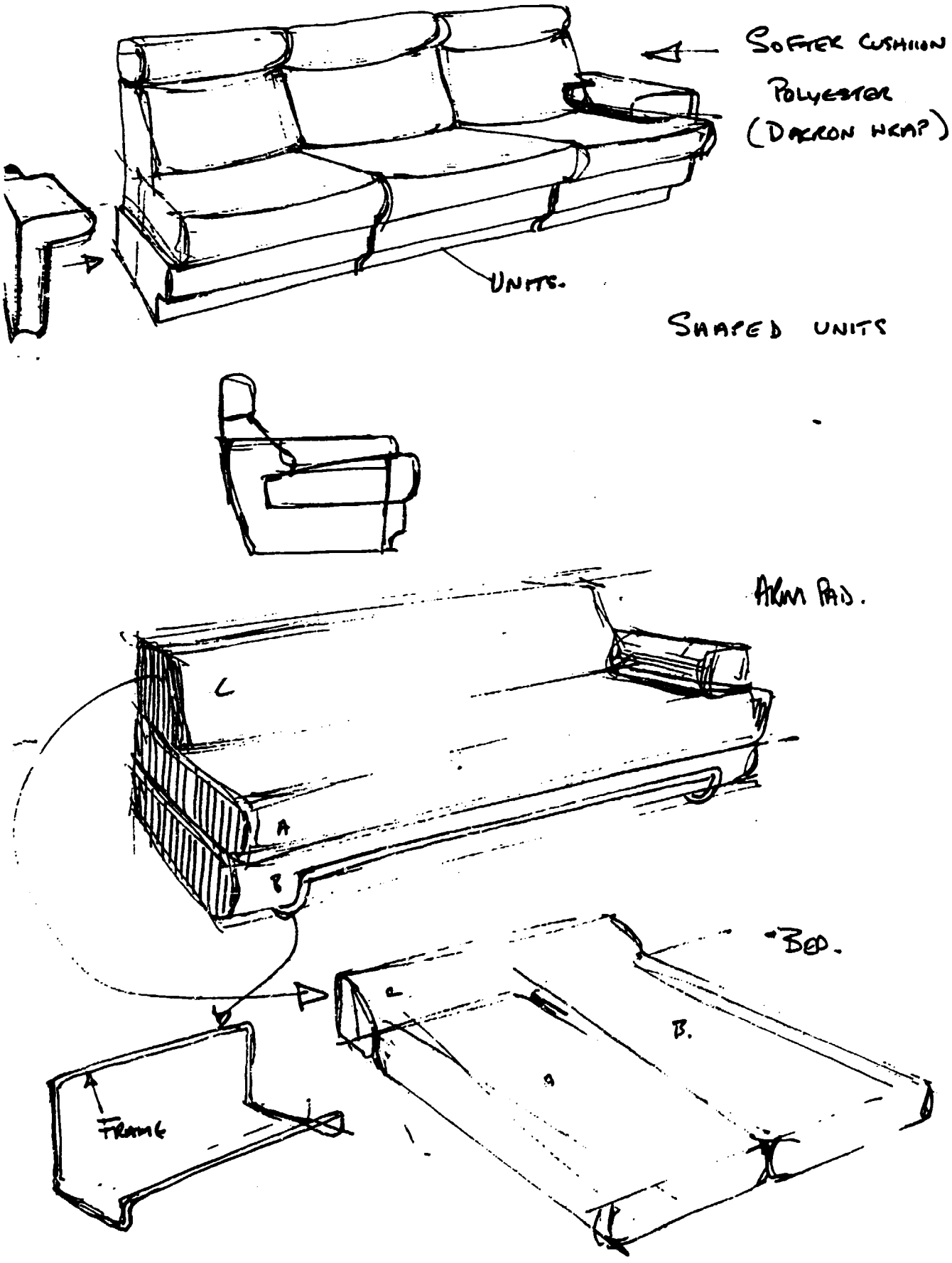


FIG. 16 SHOW - WOOD UPHOLSTERY UNITS

FIG. 17 UNIT SEATING AND MATCHING SOFA - BED



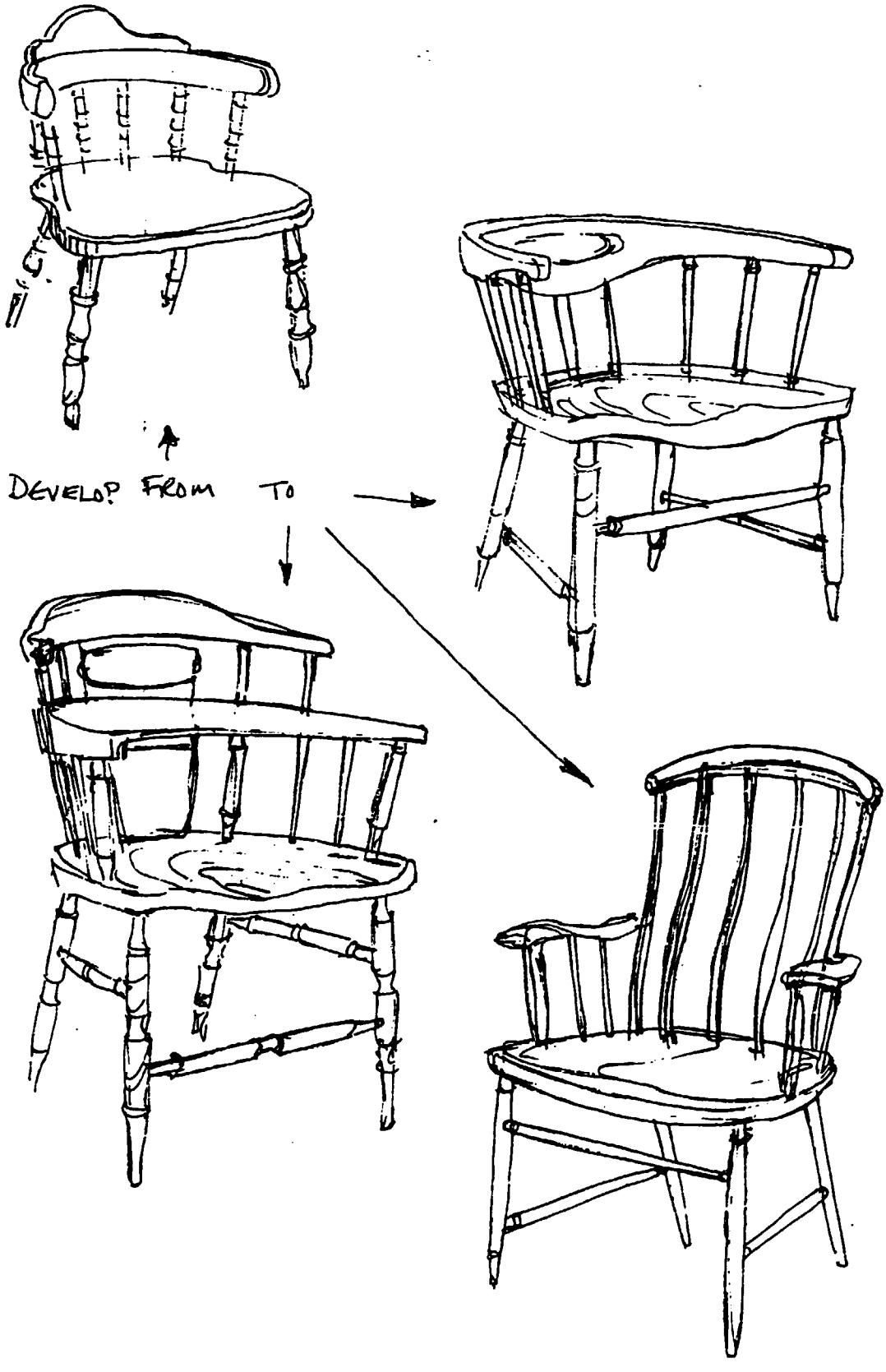


FIG. 18 CLASSIC / COLONIAL STYLE CHAIRS

ANNEX V

NOTES ON PRODUCTION MANAGEMENT AND THE TRAINING AND DUTIES OF PRODUCTION SUPERVISORS

1. The Supervisor's job consists mainly of creating by word and action, by decision and example, by orders and organisation, an atmosphere within which people are motivated to work willingly, effectively , with continuous high effort; it is a job of leadership.
   Although a new type of leadership must permeate management from top to bottom (no section, department, works or organisation can be better than the man at the top), it is at the lower level of manage ment, the level of "Supervision" as it is commonly called, as exercised by the foreman, that serious lack of leadership causes most unrest and most reduces individual effectiveness. The foreman or Supervisor, alone of the management hierarchy, is in constant daily touch with operatives, and is most frequently giving direct orders and making personal decisions. Today he is often the weakest or strongest link in the chain of command.

2. The reasons and the difficulties are not far to seek. During the past few decades, the responsibilities of managers of all grades, including Supervisors have been steadily reduced or changed. Cer tainly their power "over" people has been reduced, even if their effective power is more. Specialists are now employed to do much of the work which, in the earlier days of the industrial era, occupied a Foreman's time. Processes and methods are laid down by technicians and Production Engineers, the order of production is decided by planning Engineers, piece rates are worked out by rate fixers, costs and performances calculated by accountants, and the whole employee / employment function is the responsibility solely of the personnel function.

3. In such circumstances, Supervisors should be selected mainly for their abilities, even if latent, as leaders, and not only for their operating or technical skill, and then to train them specifically for the job of supervision. In addition to knowing the technical work being done by subordinates and associated specialists, the supervisory role consists of putting the right man in the right place, seeing that he is suitably rewarded for his efforts, giving him all the information he needs or should have, making decisions

on the innumerable occasions which are not covered by standard practice, instructions and procedures, and continuously inspiring all his team to work willingly and well.
The aspects of supervision which most immediately apply include motivation, discipline, communication, consultation, decision and co-operation, coordination and integration

4. (a) MOTIVATION

Inspiring leadership in everyday work can have astonishing results in raising men's efforts much above the ordinary level. To attain this managers must show by their enthusiasm and example that they have faith in the purpose of the job in hand and in the company's product or business, and are loyal to the company's policies, to their own seniors and to all their subordinates. It is not enough to show this on important occasions, it must be shown always in every small decision and action, in giving orders and receiving unpleasant ones, in reprimands and in commendation, in attempting the impossible and carrying out the routine jobs, in dealing with disputes and correcting or reporting grievances, in setting tasks and ensuring reward. To inspire his team and maintain a high morale, the Manager must set himself a high standard and live up to it. Respect. like authority, can not be handed out or ordered, it must be earned. Men on the shop floor have a pretty accurate assessment of their boss's character; they know him at least as well as he knows himself, and usually better. He has presumably been chosen for his superiority , and they therefore tend to set their own standard of behaviour by his. Inspiration, then, is the essence of leadership. Loyalty is a principal ingredient-loyalty to subordinates, to management and to the purpose of the enterprise. Others are keenness, which is infectious; absolute honesty in all things, but especially in descussions; interest in and liking for people, resulting in personal sympathy and understanding, readiness to face awkward situations and to accept responsibility, but unwillingness to ask others to do anything one would not do oneself; an ability to make prompt and resolute decisions, however unpleasant, and finally,a sense of humour.

(b) DISCIPLINE

Discipline on the shop floor is important, not only to prevent complete chaos developing, but in most industrial situations, adherence

to rules and regulations is vital to the maintenance of safety. There must be rules defining where people may and may not go, where and how materials must and must not be stored and handled, certain machines must be guarded, goggles must be worn for specific operations; there are many such rules for all employees to adhere to as well as organisational rules, such as starting and finishing times and so forth. The most effective precursor to good discipline is the example of the supervisor or departmental head; discipline based on the principle of "don't do as I do, do as I say" will soon lead to chaos and may well lead to serious injury. Most people respect a strict but fair disciplinarian, but very few are really happy under a lax management, for laxness in administrative rules is usually matched by laxness in safety rules and someone eventually gets hurt.
One important ingredient of discipline is consistency, you cannot jump on the relatively new employee who is five minutes late, and ignore the shop steward who ambles in twenty minutes late without explanation. Likewise, you cannot let standards gradually slide for eleven months of the year, and then have sudden "purges" of discipline once a year. Everyone likes to know where they stand. Any rules should be fully explained so that all employees know:

- What the rules are;
- Why these rules exist;
- What will happen if they break these rules.

If the rules are applied equally to all employees the discipline will not only be fair, but also respected.

(c) COMMUNICATION

Communication is a vital tool of management, probably more today than it has ever been. There are two aspects to the problem of communication. The first is the manager's expertise in transmitting ideas, or instructions to another person or group of people in such a way as to ensure that the recipient of the information knows exactly what is happening or what he is intended to do.

Not everyone in a supervisory position is necessarily good at expressing himself either verbally or in writing and so it is important to make sure by checking. Random checks can be undertaken by:

- Asking the recipient to repeat his instructions in detail;
- Asking the man on the shop floor his understanding of some information given to his supervisor.

All too frequently the only cross check is when a post mortem into an incorrectly carried out instruction reveals a misunderstanding in the initial communication. One large company investigated thirty-five unofficial stoppages of work, and found that eighteen of them were directly attributable to misunderstandings. In each of these cases when the true situation was explained the men returned to work at once, but, even so, many man hours had been lost.

The second facet of communication which management must take positive steps to achieve is the communication that replaces secrecy. Often this secrecy is unintentional; busy managers intent on their immediate problems may not find time to stop the department, call everyone together, and pass on the latest information on what is happening and why. However, : one approach to this problem is the use of briefing groups.

A briefing group is a periodic assembly of the whole department with the departmental head. be he Foreman, Manager or Director, to enable the boss to pass on to his subordinates what is happening and why, and to give an opportunity for general discussion on what needs to be done and how everyone can best contribute. To be effective briefing groups must be at regular intervals, not held only when there is some bad news to impart, or a rush job to get out. At departmental head level, once a month following publication of the monthly statistics is a good time; then all concerned can be kept alive to the fortunes and prospects of the company and so identify themselves much more with its continued success.

Finally, as communication is between people it is essential to pre - sent facts and get reactions, that is to communicate, as personally as possible. A few minutes' talk is worth more than pages of notices, and even in the talking, warmth and a sense of humour are more effective than a cold impersonal speech, however perfectly phrased.

(d) JOINT CONSULTATION

A large part of a Manager's time is necessarily spent in dealing with people, but little of it should be spent in actually giving instruc - tions. For most of the time,a Manager should be passing or receiving information as a result of which subordinates take action, if action is necessary. In doing so he should provide reasonable opportunity for the other persons to express their opinions, even if they have to

be corrected or rejected. In this way all subordinates, and the rank and file, are made to feel that their opinions count for something and that "thy matter". The larger an organisation becomes the more difficult it is to do this; information along the channels of comm nication, up and down, does not move very freely and decisions made high up may appear arbitrary.
Resistance may be met with instead of ready cooperation. More for mal means of ensuring the flow of information becomes necessary and we have what is called "joint consultation".

To the Manager, joint consultation committees and other formal means of consultation are apt to appear unwieldy and time consuming, and to undermine his prestige and authority. They can do just this if the Manager sits back and lets the committee do his work for him. But he must be continually alert to ensure that people turn to their immediate superior for information or advice, and that information affecting people gets down to them from above quickly and sympathetically. This leaves the formal committee to deal with the inevitable grumbler and cases which go off the rails, usually due to personalities, and to act as a safety valve. All too frequently the communication channel is from senior production management to shop floor via shop stewards at a joint consultation meeting. It is rarely practical to have all foremen or other line managers present at the (monthly) JC meeting, but it is essential that these supervisors are given the same information before the works people responsible to them. There is little that undermines a supervisor's position more than being told "what's going on" by his subordinates. In addition, if a particular point has been either intentionally or unintentionally misrepresented in the telling, then the foreman must be in a position to correct it in the minds of his men.

(e) DECISION

Decision is another important element of leadership, and the nice balance between the impetuous hasty decision and a hesitant or procrastinating one has to be cultivated. There are some people who find great difficulty in making up their minds and sticking to a decision. Highly skiilled technical persons and those trained in research often do not make successful managers for this reason; they have been so used to looking all round a question in every detail that they are unable to make a decision rapidly. Although it

is essential to be able to make a decision, it must not be thought that it is possible to do so without a knowledge of the facts, and without a good deal of thought. A manager must not always be forcing his ideas; he must be a good listener as well as a good talker, and above all he must be able to get others to contribute their ideas and facts, and as far as possible. to share, or feel they share, in the decision.

When all the facts of a situation are found, all concerned, supervisors and operators, obey the law; there is not the same feeling as when obeying orders. Authority can still be exercised, but it is the authority of the facts of a situation.

(f) COOPERATION, COORDINATION AND INTEGRATION

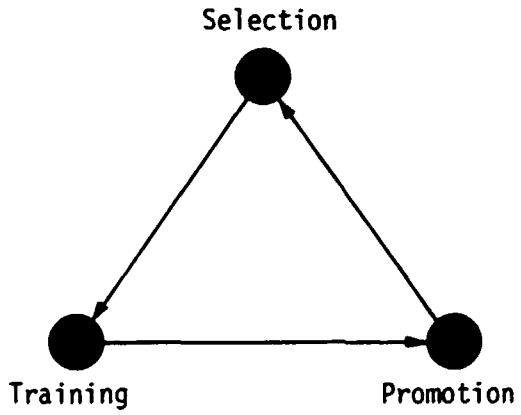
These are elements of the technique of organising action. Cooperation is really a state of mind that can exist only on a basis of knowledge and appreciation of a common purpose that is understood by all. Likewise, coordination needs all concerned to have all the information necessary at the time common effort is required. Integration requires a pooling or gathering together of all the facts and ideas for the purpose of arriving at the best solution to a problem, one which is likely to be better than any one person's solution. In each case a sharing of information is required. In practice it means that there must be frequent meetings between those concerned, not necessarily large or formal meetings, but at least some opportunity to exchange views, ideas and facts. Under wise leaders this cooperation, coordination and integration ensures harmony, progress and effectiveness of the whole team. This is not a plea for formal meetings or committees; far form it. The atmosphere of committee rooms is apt to be deadening and sterile. But it does mean that the practice of bringing together those whose activities interlock is a good one and should take place at all levels.

5. SELECTION AND DEVELOPMENT

Because selection and training schemes are matters in which the Personnel Officer advises and undertakes a good deal of the work, this does mean that they are no longer the line executive's responsibility. Ultimately the head of a department is responsible for the people he has working for him, and he must retain the final right of decision about people added to his staff, retained or promoted. He has the duty of

requesting and considering the advice of the Personnel Officer, but he himself must make the final decision.

The skill of choosing subordinates is one which the young or newly promoted manager must learn, if he is to be successful. Many reorganisations would not have been necessary, and many unhappy organisations would not be so, had the executive at the head been skilled in the choice of men. Few persons remain what they are at an early age. All are susceptible to training - particularly good and stimulating training. So this is equally important; and it makes for more stability and loyalty than introducing persons into an organisation from outside at a high level. To choose good material at an early age and then to train means that each promotion is also a selection, so that selection, training and promotion, vital elements in management, form as it were a triangle thus:



Skill in selecton of staff demands of executives that they shall be good listeners and better observers. Dominant men usually get "yes men" round them. To learn of a man's abilities and potentialities one must draw him out and encourage expression of views and abilities; this can only be done by giving him his head as far as possible. Although much improved techniques have been developed to aid selection by interview and test, they are not sufficient by themeselves, and personal evaluation, particularly of character and personality, has still to be relied on. Such evaluation should be continually

practised if it is to be reliable. For it to be practised only in the case of important appointments and for the inevitable mistakes to be made is expensive and wasteful. But it can be practised without actual appointments being involved by studying the behaviour of people one meets and checking one's judgment later. It will be found, except in rare cases, that a conscious effort of evaluation has to be done, otherwise the decision will be affected too much by emotional reactions and personal likes and dislikes.

It is a good practice for the manager to have a list of all his direct subordinates who would be contenders for his position if he himself were promoted. Against each he should record proficiency in the technical skills required for his job and also points on the personal qualities requires. Analysis of the chart will frequently show a few "contenders" each with various shortcomings, in technical knowledge, experience, or personal qualities. The manager should then take steps to initiate a training programme to make good those weaknesses. To do this it is not always necessary to let the men concerned know that they are in the running. The manager should know his subordinates well enough to know whether silence or knowledge will get the best results.

6. PERFORMANCE

Most of us like to know how well we are doing. In industrial activity it is essential. A company must render an account at least once a year of its financial results. But the trading account is the results of the individual and collective actions of all employees from day to day in discharging their task, whatever it may be, and it is equally necessary for an account to be rendered on the results of their work, that is, of their performance. This is done for operators on piecework, since their output is measured. One of the very real advantages of measuring piecework on a time basis is that the percentage bonus is a measure of performance which can be used for comparing individual and collective or departmental results.

Managers are responsible for the work, and hence the performance, individual and collective, of all employees under their authority. The total bonus percentage of a department is obviously one measure of departmental performance for which the Foreman can be held responsible. But there are other performances, often not measured or not measured accu-

rately. Perhaps the most important of these are: total overall costs per unit or production (for example, per standard hour), and excess costs. In some cases machine utilisation is equally important, as in furniture component processing. Although the quality of the product is usually checked if not controlled by the Inspector, the production Manager is responsible for results. All managers must see to it that they have accurate reports of all such measures of performance relating to their department and take energetic steps to improve performance continually.

Whether the company operates piecework or measured daywork there will be a weekly calculation of each operator's individual perform - ance. Each shop supervisor should receive a copy of the figures relevant to his department, a suggested format is shown in Fig. 1, and the production manager should have at least a summary showing section averages and factory average.

FIGURE 1

Clock no.	Name	Total hours	OT	Hours on incentive	Performance %

The supervisor should scrutinise the figures weekly, particulary good performances should be complimented - "an ounce of appreciation is worth a ton of reprimand". This also applies to good departmental performances. Poor performance, particularly when out of character, should be investigated, not so much to administer a reprimand, though this may sometimes be necessary, but to determine whether poor performance highlights a training need, equipment shortcomings, or perhaps personal worries about situations outside the workplace. In this case help from the personnel department may be required. With labour performance figures it is the significant change rather than the general level that is important.

Supervisors should also be trained to understand and take action on the labour cost return for their department. The most important measure is the cost per unit of output, a significant rise in this figure is cause for immediate investigation. Other sections of the report will indicate the areas requiring investigation, e.g. waiting time, rectification, excessive setting and so on.

The performance of finished parts, or the quality of products, are other aspects of performance. It is often thought that this is the Inspector's responsibility. It is not. Quality of product is the Supervisor's (Manager's or Foreman's) responsibility; the Inspector is really the representative of the customer (or Assembly Department or Sales Department), and is employed as a guardian of quality. The Production Supervisor must, in the end, produce a good quality article, and it is for him therefore to get and use reports on the performance, or quality, of his product. As with labour, he must look for incidence of cause and follow up in an endeavour to cure the cause. Nor is it right to assume that there must always be some waste or scrap, or that a normal figure needs no further efforts to reduce it. It is surprising to how low a figure scrap and faulty work can be reduced if the effort is made .

7. PRODUCTIVITY

During the past ten to fifteen years there has been much stress laid on productivity. It is of course a very important index; however, its importance is not matched by its ease of measurement. Output per man hour is an index of productivity which can be measured in one factory or plant in one year, using value of sales and labour hours. This will give a false picture of productivity improvement if selling prices are increased without a change in labour hours. Even the use of the productivity ratio standard hours produced/actual hours worked ignores the use of capital in the enterprise and thus prevents meaningful comparison between companies. One index of productivity that enables these points to be taken into account is added value per employee related to the company's capital intensity. The concept of added value is now familiar to most people, but its relation to hours worked, number of employees, or capital employed has not had a wide recognition as a productivity index .

Whether the company uses the ratio of standard hours produced to

actual hours worked, or one of the added value based indices, it should be remembered that it is better to have an imperfect measurement of productivity within the establishment than none at all.

8. CONTROL IN ACTION

The manager of a production unit, Production Manager, Works Manager, Supervisor, or whatever his status title, must spend quite a large part of his time "controlling" the activities for which he is responsible, that is, checking performance against programme or standards and taking action to correct errors or undesirable trends. The higher a manager's position in the organisation, the more he will have to judge results from reports and other documents (such documents should therefore be designed to make deviations, shortages, excess costs, overdue items, etc., stand out from the mass of figures).

Cost control reports, presenting performance figures and analysing excess costs according to cause, should be used down to supervisor level, the Production Manager scrutinising them first, and discussing with his subordinates significant items, they in turn taking up in more detail with their assistants.

The Production Manager will examine other manufacturing expediture by comparing with his budget. He will have discussed this with his managers before it was agreed and will likewise discuss results with them when they are known, usually at monthly intervals. Time should not be wasted in going through every item, but thought should be given to items in excess about which something can be done. The Production Manager will also need to check output, preferably weekly, against the Planning Department's programme, and, if manufacturing to customer's delivery requirements, overdue deliveries. Failures here may involve rearrangement of production facilities, overtime or extra shifts, or additional labour, and conferences with the managers concerned. He will also watch earnings as an index of performance. Reports on stock levels and items (purchases or finished) out-of-stock will need to be discussed with the Buyer, Storekeeper and possibly Planning Manager, and again production plans or purchasing programmes may have to be adjusted with changes in material supply. Likewise, reports from the Personnel Department on absenteeism and turnover may indicate action, either in the organisation or in respect of labour recruitment.

There will be other control reports used by a particular company. The important thing is that the Production Manager should not just receive, read and file reports, but should at least frequently, if not regularly, discuss doubtful or unsatisfactory, as well as good, results with the persons responsible. In this way the reports are kept alive, and those responsible for results are concerned to do something about them. Pro - duction is under control.

This concept is the background and basis of management by objectives, in which the management control process of:

determine targets
operate
check performance

has been formalised to a regular, say six monthly, pattern. The principles of management by objectives are not new; indeed they are just good management in action. The need for management by objectives, however, is that in many organisations and for many people this does not happen unless it is programmed, introduced by an "expert", or given a new fancy name. But whether it is done formally under such a title or informally as good production management, it must be done. Then the manager will be managing, and he will be achieving the objectives of his position as Production Manager.

PART II
GUIDELINES FOR SUPERVISORS

1. GENERAL

i. The best kind of supervision comes as a result of training. So make sure that your workers are properly trained to do the job. This applies particularly to newcomers to your section.

ii. There is no substitute for direct and full time supervision. You must be with your section all day every day, and ensure that in your unavoidable absence, someone also takes over. This is one of the greatest needs of the factory at present.

iii. Apart from the toilet, a worker has no business being in any other part of the factory without permission. If he comes into another department, he should be instructed to leave immediately.

iv. Punctuality is an important contributor to productivity. Even minutes count. So see that your workers always start and finish work on time, including lunch and coffee-breaks.

v. In the case of absences, including your own, always make sure there is someone else capable of taking over the job, and that your stand-in is well briefed before your departure.

vi. Your workers must come to you and no one else for all permissions, and must never be allowed to leave their work-places without your permission. They should also report to you on their return.

vii. No worker should be permitted to leave his workplace without permission, and this must not be given except for genuine reasons. In that event make sure that his absence does not disrupt work elsewhere.

viii. When giving instructions to your workers make sure that you are fully understood. Remember that one simple sketch can be worth a thousand words.

ix. Instructions and corrections should be given firmly but tactfully.

x. You must consult with your fellow supervisors in other departments daily if not hourly, so that there is complete harmony throughout

the plant. This applies in particular to those departments which are inter-dependent e.g. machining, sanding, assembly and finishing. You must never discuss another colleague on the supervisory staff with any of the workers.

xi. Toilets should be hosed out and disinfected daily, if that is part of your responsibility.

xii. No materials permitted on the floor - always us pallets and conveyors.

xiii. Clearways to be kept clear always.

xiv. When a pallet or trolley load has completed one process it should be immediately removed to the next machine or intermediate storage waiting area.

xv. The foreman's most important job is to ensure that his men
(a) Never have to leave their machines or benches except for personal reasons.
(b) Always have plenty of work in front of them.
(c) Always have the means to do the job satisfactorily, i.e. machines set up, all the right materials available, etc.
(d) Always have the work moved on to the next station when completed.

xvi. Waste bins must be provided for every machine and should be emptied daily.

xvii. Waste occurs mainly at the break-down stage i.e. X-cuts and circular saws. Ensure that it does not move further up the factory.

xviii. Space is very valuable - if there is not a <u>good</u> reason for material occupying space then get rid of the material - whatever it is.

xix. Under no circumstances should a job be started until everything needed to complete the job is available.

xx. Ensure that the instructions you give your men are fully understood by them. If they have never done a particular job before, then you must instruct them clearly on how to do it.

xxi. Try to anticipate difficulties and problems which might arise, e.g. cutters requiring to be sharpened, sanding belts needing to be replaced, one of your men running out of work shortly, etc.

xxii. When issuing instructions to your men, do so firmly but tactfully otherwise you may get their backs up and their output down.

xxiii. If a man is appointed to operate a machine or work on a bench, then 100 % of his time should be on that work and not on fetching and carrying. There should be others for that work and it is part of your job to see that your production men remain fully productive.

xxiv. Be quality conscious yourself and make sure your men are also . Do not use defective materials.

xxv. The time to discover a mistake is not at the final stage of production, but when it occurs.

xxvi. A new man coming into your section has to be specially trained and instructed. Just think back on your own first day at work.

xxvii. The successful factory is the one where there is co-operation between people. Co-operation is ensured by keeping people informed. Confer daily and even hourly with your fellow supervisors in each department.

xxviii. All work areas, assembly benches etc. must be clean and tidy at all times.

xxix. Always have your daily production programme prepared at least one day in advance.

xxx. Always complete your daily production report at the end of each days production.

2. WOODMACHINING

i. This is the key area in any furniture factory. If machining is done properly then there are few if any problems in assembly and finishing.

ii. Make sure each worker is carefully instructed in the purpose and safe operation of each machine he uses.

iii. Ensure the lighting over each machine is adequate to the accurate use of the machine. Make sure each operator does not suffer from defective eyesight.

iv. The best kind of machine maintenance is preventive maintenance. This way you will ensure avoidance of unexpected breakdowns and shortages of parts and tools.

v. Try to avoid bottlenecks in machining by balancing the work - flow and ensuring an even distribution of work to the various machines. Where a machine is over-loaded arrange for some of of the work to be done elsewhere.

vi. When a machine has been set up it should then be checked, preferably with a gauge, before commencing batch production. It should subsequently be checked again at intervals to ensure there is no departure from the standard.

vii. Correct sharpening of cutters and cutting tools will ensure accuracy and better performance

viii. Always use measurement gauges for setting up and checking the accuracy of machining; avoid the use of tapes and rulers as their accurate use depends on individual eyesight and judgement.

ix. Few machines require more than one helper; make sure this is always the case.

x. Woodworking machines operating at high speed require the full - time attention of the operator. Make sure he is not distracted in any way.

xi. Make sure the dust extraction system at each machine is operating satisfactorily. Even partial failure of the system can have serious effects on the efficiency of the machines.

xii. All dust etc. should be "blown off" the machine each evening before shutdown.

xiii. Jigs and formers which are used in conjunction with a particular machine should be kept on a rack close to that machine.

xiv. All jigs and formers should be made from plywood, and wearing surfaces should be protected by a hard wearing material like Tufnol, Hydulignum, Metal or Plastic Laminate.

xv. Master parts, painted a vivid orange should also be available where necessary at the machine for checking purposes.

xvi. When a batch of components has been processed at any machine, it should be immediately moved to the waiting area of the next machine in sequence.

xvii. Stacking on pallets should always be done carefully. This way it is easy at any stage to count the number of components.

xviii. Where two machines are used in conjunction with each other e.g. bandsaw and router for shaped components, they should be located close to each other.

xix. Records should be kept on each days production and explanations should be given for variations from standard production times. It is easy to monitor and measure output per machine.

xx. In no circumstance should waste or rejects be allowed to accumulate around any machine. The factory floor is for work-in-progress only.

xxi. As much work as possible should be done at the machining stage. This includes provision for handles, locks, hinges, movements shelves etc.

xxii. Remember that the machining section should always be at least <u>one</u> week ahead of sanding and assembly. Therefore you should always maintain a buffer stock of machined components,

equivalent to one week's output..

xxiii. Since there is sometimes absenteeism in the plant, make sure you always have at least one stand-by machinist capable of operating the machine in the absence of the usual operator.

xxiv. Particular care should always be taken to ensure that the setting-up of a machine is checked before the machine is set in motion. Many serious accidents can be avoided ir this way. Also make sure that all guards, and other protective devices are used on all occasions.

3. MACHINE SANDING

i. Those operating the sanding machines should be reminded that the quality of the lacquering system is totally dependent on the quality of the sanding.

ii. The lighting therefore in the sanding area should be of sufficient intensity to allow for accurate checking of the sanding process.

iii. They should be familiar with the use and maintenance of:

a. conventional belt sanders,
b. Type of abrasive belt: size (lengths, width and thick - ness); different grades/grits; backing; resistance to clogging.

iv. When operating sanding machines, they should be familiar with the following:

a. operation of ISOLATING/MASTER switches,

b. warning light system (where fitted).

c. SAFETY precautions:
- correct adjustment of guards,
- risk of injury from sharp edges of belts,
- avoidance of trapping between rollers and belts,
- or belts and materials,
- avoiding contact with moving parts particularly loose clothing being trapped,

- careful handling of belts,

d. tensioning and centring of belts,

e. adjusting the bed height,

f. general adjustment e.g. holding down wheels, sanding widths, downward movement of pressure pads.

v. The following are daily operator maintenance tasks:

a. SAFETY precautions including:

isolating the machine,
ensuring that all parts are stationary,

b. preventing the accumulation of dust in the machinery by blowing out frequently,

c. avoiding dust accumulation,

d. checking the sanding belt for wear and replacing when necessary.

vi. The sanding operator must recognise and appreciate the possible causes and take the appropriate remedial action in the case of such FAULTS as:

a. indentations,
b. bruises,
c. scratches,
d. uneven sanding,
e. over sanding.

vii. Encourage the sanding operator to check his finished work not only visually but also by "feel" and touch.

viii. There should always be one helper in the sanding area.

ix. The operators must keep or have kept for them a strict account of their daily production, and this must relate to standards set.

x. Workers are permitted to sit at their sanding machines where appropriate.

4. ASSEMBLY - ASSEMBLERS AND CARPENTERS.

i. The main work of the carpenter/assembler may be summarised as follows:

a. identifying piece parts with work instructions,
b. inspecting parts, correcting faults and fitting,
c. making up sub-assemblies,
d. constructing main assembly,
e. preparing the assembled item for the finishing process.

ii. The carpenter/assembler should therefore be capable of using and maintaining all the basic hand and power operated hand-tools.

iii. He should be familiar with all cramping and framing procedures both mechanical and manual, including the special pneumatic equipment used for the assembly of carcases (large and small) and frames including chair cramps.

iv. Tha carpenter/assembler should be reminded that his is the last stage before finishing, and that the success of the finishing, (i.e. Sanding and lacquering) depends in large measure on the quality of <u>his</u> finish.

v. The carpenter/assembler should have the ability to select the most appropriate of his skills for any given task. This means a capacity to plan his work and to decide for himself:

a. the most economic use of materials,
b. the tools best suited for the job,
c. a logical sequence of of operations,
d. the best layout of his workplace.

vi. In the preparation stages of his work he should be capable of:

a. identifying the material,
b. verifying that the shape is correct e.g. joints,mouldings etc.
c. checking that dimensions are within the required tolerances.
d. inspecting the quality e.g. freedom from unacceptable flaws,
e. where necessary, pairing (matching) and matching such items as door stiles, arms, etc.

vii. He should be able to recognise and understand the cause of such basic faults as:

a. material quality faults such as distortion, cracks, shakes, stain marks, etc.

b. machining quality faults such as cutter marks, snaking, burn marks,
c. inaccurate dimensioning. (It will be necessary to know and apply the acceptable tolerance),
d. out of true or shape.

viii. He should be familiar with all holding devices such as vices and cramps including:

a. use of packing or protective pieces,
b. risk of damage or distortions from over tightening, hammer marks,
c. methods of checking for true and squaring where necessary.

ix. He should be familiar with the use of jigs, fixtures and locating devices. These should be periodically checked for trueness and accurancy of dimensioning and should be maintained in that condition.

x. Tha carpenter/assembler should invariably observe the following sequence for all assemble procedures:

a. trial fitting of basic components,
b. laying out components in the correct sequence for assembly,
c. applying adhesive where necessary,
d. assembling, starting with base components e.g. bottom rails and stiles.
e. locating joints correctly, seeing that all gaps are closed, and that the work is square,
f. securing joints e.g. dowelling, wedging, pinning,
g. removing surplus adhesive,
h. checking reverse side and re-moving surplus adhesive,
i. handling the assembly while the adhesive is still wet,
j. laying aside stacking for adhesive to set.

xi. In carrying out sub-assembly, assembly work the carpenter/assembler should understand the purpose of, and know when to use the following: dowels, wedges, staples, screws, fasteners. This should include:

a. knowing why a particular fastening or combination of fasteners is used,
b. selecting the appropriate size,
c. setting them out i.e. correct positioning,
d. correct securing, punching, counter-sinking or trimming as necessary.

xii. He should also:

a. recognise well fitted joints, and be capable of making adjustments where necessary,
b. in making up frames, have an understanding of the contruction principles,
c. know how to secure cladding to frames,
d. in making up flat panel carcases, appreciate the differences between this method of construction and framing.

xiii. Line production will include a knowledge of the following:

a. method of controlling the supply of materials e.g.:
   i. calculating correct quantities from parts list/batch,
   ii. delivering machined parts e.g. stacked on pallets,
   iii. matching ironmongery to machined parts,
   iv. checking of components against the job by the carpenter/assembler;

b. the machining of parts to allow the immediate fitting of ironmongery e.g. locks, hinges;
c. shop layout:
   i. pallets/stacks, conveyorisation placed to facilitate assembly operations,
   ii. economic use of floor space. It may be appropriate to mention the cost of floor space,
   iii. maintenance of clear aisles,
   iv. contribution of maintained, methodical layout to safety and productivity.

d. workplace layout:
   i. tools and materials to hand,
   ii. adhesive in correct containers, ready for use but secure from accident,
   iii. ironmongery such as staples, screws etc. in separate container/compartments;

e. the logical sequence of assembly procedures:
   i. order in which assembly is carried out e.g.

      ends to cross rails/ties
      top and bottom,
      back

plinth/legs,
doors, drawers etc.

ii. planning the production of sub-assemblies to coincide with the main assembly operations,

iii. avoiding in-effective work e.g.

careful handling to eliminate damage,
minimum movement/handling of material,
only essential surface preparation at each stage.

f. provision for the maintenance of quality standard e.g. defined standard, inspection,

g. the role of work study in providing an analytical approach to the development of layout and methods of work.

xiv. For final assembly and fitting, the carpenter/assembler should have a thorough understanding of the standard of finish necessary before the final lacquering processes can be carried out. He should know how faults at this stage can be exaggerated by the finishing process.

xv. He should know the correct fit for doors, drawers and how to adjust them so that they operate smoothly.

xvi. Where ironmongery is fitted during the assembly stage he should know to mark, remove, and store it before the work goes for polishing, and refit it without damage.

xvii. With regard to repair work, he should be capable of stopping, cuttingout damage or defects and fitting matching inserts/ plugs.

xviii . Strict supervision of this section is essential at all times and particular care should be taken to ensure the following:

a. that each carpenter has plenty of work ahead of him, and that all his completed work is checked and removed immediately to a storage area to await finishing,

b. that he makes proper use of his bench and assembly platform.

c. that strict account is kept of each man's daily output and that basic times are established for each process,

which are strictly adhered to,

d. that each completed model is immediately placed on a live pallet for removal to the finishing area,

e. that a buffer stock of machined and sanded components is maintained so that work in this area never slackens,

f. that no assembly work is begun until all components have been thoroughly sanded.

5. FINAL INSPECTION AND TOUCHING UP

i. You must be completely familiar with all the specifications and quality requirements for each Artepractico model.

ii. These do not change from one design to another, but are uniform throughout the whole range.

iii. Your job is to ensure that the quality standards applied at every stage of production from the machining to the lacquering of the finished product are done consistently and well.

iv. Apart from that you will make whatever final adjustments or touching up are deemed necessary so that the product leaves the factory in accordance with the high standards and good reputation enjoyed by all Artepractico furniture.

v. At the same time you must not overdo this function, bearing in mind that there must be a careful balance between the cost of final finishing and the standard to which the customer is normally entitled.

vi. On the other hand if you detect a serious fault of defect in the item which, in your opinion, was caused by carelessness at some stage of production, then you must trace the fault back to its source so that it will not occur again.

vii. Only when your are satisfied that the required standard has been reached should you apply the "approval" stamp on the product.

6. LACQUERING AND POLISHING

i. Finishing operatives should be made aware that finishing materials and their solvents are expensive, and that a considerable loss of material can occur through bad working practices. An example is the wastage due to fog loss when unnecessarily high pressure is used on a spray gun.

ii. They should also be made aware that finishing must be done only in a clean, dust free area where daily brushing after work has ended will ensure the right working conditions.

iii. Doors leading into and out of the spray area should always be kept closed and only finishing personnel should be allowed to enter the finishing area.

iv. Operatives should fully understand the nature of the materials they are using with particular reference to the following:

a. shelf life,
b. pot/working life,
c. curing times including accelerating/retarding agents,
d. working temperature,
e. flash point,
f. compatibility with other materials,
g. relative costs.

v. They should also know the characteristics of the finished coat, and their effect on the use of the lacquer e.g. resistance to damage, hardness, durability, texture, clarity and the effects of "aging" or sunlight, methods of application.

vi. The finishing system recommended is a two pack polyurethane lacquer, it has a high resistance to heat, moisture, and such chemicals as nail varnish remover. It is, however, relatively expensive.

vii. It is essential that the finish be applied to a sanded surface free from grit.

viii. The operative should be as familiar with sanding techniques and sand/finishing standards as the sanding operator.

ix. The operative should know the characteristics of the stains used and understand the reason for using them including such factors as:

a. when a natural (unstained) finish could be used,
b. staining to enhance the appearance of colour,
c. "toning" effect without concealing the grain or colour,
d. varying the intensity of the base stain to "match" grains.

x. When fillers are used he should understand the following:

a. characteristics of paste fillers,
b. accelerating or retarding drying times,
c. staining filler to match base stain or to create an effect.

xi. The purpose of the sealing coat should be understood together with the use of flatting agents, and the effects of sand papering sealing coats.

xii. With regard to matching, ensure that stains are selected to match the base colour and that matching stain incorporates a binding agent to bond with the sealer coat.

Spray gun operators in particular should be instructed in the following:

a. HEALTH and SAFETY including:

i. toxicity of fumes,
ii. use of protective gloves, mask and barrier creams,
iii. fire precautions,
iv. action on the outbreak of fire,
v. dangers associated with compressed air,

b. equipment and principles of operation:

i. motor and compressor,
ii. receiver,
iii. air transformer,
iv. compressed air supply,

c. Spray booth:

i. purpose and operation of the booth,
ii. cleaning the booth,
iii. extraction equipment,
iv. fire or explosion risks from sparks.

v. the hazards presented by tne accumulation of waste material.

d. Spray Gun

i. components.
ii. types of gun and feed,
iii. air and lacquer flow and control,
iv. air and fluid lines,
v. operating the gun,
vi. adjusting the spray pattern.

7. ENGINEERING

i. The engineering department is responsible for the following:

a. Preventive maintenance and good working order of all machinery, equipment and tools,

b. all electric, pneumatic and hydraulic work,

c. compressed air-line and dust/waste extraction systems,

d. all cutter and saw grinding and sharpening,

e. fabrication of all metal parts for machine jigs, fixtures and formers,

f. fabrication where possible of machine spares,

g. maintenance of all vehicle and internal transport system,

h. fabrication of special fittings and tools when required,

i. general building maintenance,

j. maintenance of machinery and equipment log-book containing full details of every machine in use including purchase date, name and address of supplier, dates and nature of over-haul, servicing and repair, availability source and supply of spares and accessories , any other relevant information,

k. work closely with prototyping and product development in the technical aspects of production planning.

Sources: 'The Principles and Practice of Management' edited by: E.F.L. Brech. Part 3. 'Manufacturing Supply and Technical Development' by R. Field.